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COL. Z. S. SPALDING,
Second President of Hawaiian Sugar Planters' Association,
1883.

There has been no material change in the price of Sugar, since our last issue. The immense beet-sugar crop of Europe, with its surplus of 600,000 tons, will probably prevent any immediate improvement in the present low price.

We surrender this number of the Planter to a part of the full and very interesting reports read at the annual meeting held in November. Such as do not appear in this, will be published in the following issue. Foreign cane planters cannot fail to obtain from them some new and valuable hints.

A public park located on the Palama or the upper Nuuanu road, two miles from the Post-office,—if such a site is obtainable—would be the most appropriate memorial to the late President McKinley. Like "Thomas Square," it would in time become a popular resort and perpetual memorial of one of Hawaii's best immortal friends.

The sugar crop of Hawaii for 1901, has exceeded the most liberal estimates, having been 360,000 tons. Fine harvesting weather and an increased supply of water for irrigation from artesian sources, have been the chief factors in producing this result. Under like conditions, the next crop will be fully as large.

Notes.—The largest production of refined sugar in the United States for any single year was that of 1899, which was 1,773,870 tons. The production of 1900 was 1,566,038 tons. It is estimated by those in the trade best qualified to judge that the American Sugar Refining Company produced about 80 per cent of the output in each of those years.

Louisiana advices regarding the cane crop state that the weather has continued excellent for the cane crop, and the reports all indicate that the cane is riper than is customary during the grinding season, and the juice is testing high in sucrose, and is also yielding a satisfactory tonnage per acre.

The Havana correspondent of the Louisiana Planter states that of all the districts of the island of Cuba, that of Remedios is undoubtedly the one in which the reconstruction in agricultural interests is making the most progress. The greater part of the central sugar factories in that locality are being reconstructed, and in view of the great activity that is being displayed, it is to be presumed that within two years the sugar production in that part of the island will be the same, and perhaps superior to that had before the war.

The true way to produce high prices is to produce something a little better than can be found for sale.

TWENTY-FIRST ANNUAL MEETING OF THE HAWAIIAN SUGAR PLANTERS' ASSOCIATION.

The annual meeting of the Planters' Association was held this year in the hall of the Castle & Cooke building of this city. It convened at ten o'clock of Monday, Nov. 18, with an unusually large attendance, there being present representatives from all the plantations.

The president of the Association, Mr. F. A. Schaefer, opened the proceedings by reading an address of welcome, detailing on behalf of the board of trustees the principal transactions of the past year. We insert his address in full.

HONOLULU, November 18th, 1901.

GENTLEMEN:—Another year has passed away since the members of this Association met in annual session and we look back upon a year of arduous efforts of the Trustees and the Managers of the various plantations of this Territory to overcome the difficulties with which the sugar industry had to contend. You are so thoroughly conversant with the labor troubles and the serious results which have arisen therefrom to every plantation of this group that I need not refer to this subject at great length. Although the situation has improved somewhat, the scarcity of labor has not ceased to exist and it will require the continued efforts of this Association through its trustees to provide for an increase of available labor to supply the demand.

The outlay of capital for immigration purposes has been very large during the year now closed, but in full realization of the urgency of such expenditures all plantations of these islands have readily contributed their share in equitable proportions to the whole.

Exceptionally dry weather prevailed in some districts of the islands of Hawaii and Maui, particularly in Hamaku and Kohala with such disastrous effect on the growing cane that the crop of 1902 is expected to be reduced by it to a very considerable extent. This drought lasted for a period of six months with but light showers of rain intervening.

Sugar prices as compared with the preceding year, show a decided decline and I believe the difference in the net proceeds to be approximately $10.00 per ton. This is in itself an immense deficiency which is the more seriously felt as through excessively high wages and other causes, the expense of sugar manufacture has greatly increased at the same time.

Mr. R. C. Blouin was engaged by the trustees to succeed Dr. W. Maxwell as Director of the Laboratory and Experimental Station and made a successful start in his work, visiting also every plantation of these islands and thus making the personal acquaintance of every manager and gaining his information on the spot. I believe that Mr. Blouin did not only make friends for himself among the planters, but proved himself a man of high scientific attainments and of good practical experience which adapted him particularly for the position he was called upon to fill. It was a matter of regret to the trustees therefor to have to accept Mr. Blouin's resignation, necessitated by the latter's protracted illness brought on by climatical causes. Nevertheless Mr. Blouin has sent in an annual report to the members of the Planters' Association which contains much valuable information and careful work and will be perused with interest. A successor to Mr. Blouin will shortly be appointed, but so far the trustees have not taken any decided steps in that direction.

The laboratory and experimental station are at present located all together on the Makiki grounds of this Association and I would recommend to the members to visit the station if convenient, as it is of interest to every one directly or indirectly connected with the sugar planting industry. Mr. C. F. Eckart is temporarily in charge of the station and has filled the position satisfactorily. As chairman of the Committee on Fertilization Mr. Eckart has prepared a valuable report to be submitted at this session.

Among other subjects for mutual discussion and exchange of views, probably the subject of rates of wages will be the most important and it is to be hoped that unanimity of action will solve this problem to the best interest of all concerned.

Reports of committees on various subjects will be submitted to your consideration as usual and there remains nothing for me to enlarge upon. But I bid you a hearty welcome and I hope and trust that your deliberations will be productive of a good understanding among your good selves and be beneficial in many other ways."

The Secretary then read a report, detailing the principal transactions of the board of trustees at their various meetings as well as the importation of laborers, and other matters of business in which the Association is interested.

At the annual meeting held in October, 1900, the following gentlemen were elected trustees of the Association: F. A. Schaefer, J. B. Atherton, H. P. Baldwin, W. G. Irwin, F. M. Swanzy, H. A. Isenberg, Geo. H. Robertson, W. Pfotenhauer and C. Bolte.

The trustees so elected chose the following officers for the ensuing year: President, F. A. Schaefer; Vice-President, C. Bolte; Treasurer, H. A. Isenberg; Secretary, W. Pfotenhauer; Auditor, J. B. Atherton.

In April, 1901, Mr. Bolte resigned as Vice-President and Trustee, and Mr. W. G. Irwin was chosen to fill the vacancy; and in July of the same year Mr. B. F. Dillingham was elected trustee in place of Mr. Bolte, resigned.

In August, Mr. H. A. Isenberg resigned as treasurer and

Mr. Pfotenhauer resigned as secretary and trustee, and Mr. W. O. Smith was elected trustee, treasurer and secretary.

In October, Mr. J. P. Cooke was chosen auditor in Mr. J. B. Atherton's absence, and Mr. R. D. Mead was appointed acting secretary and treasurer during the absence of Mr. Smith.

Forty-three meetings of the trustees have been held during the year, besides many conferences.

The attention of the board of trustees has been devoted very largely to the labor question. As usual, since the formation of the Association in 1882, the question of obtaining laborers for agricultural and mill work has been one of the most important. During the past year, after much difficulty, 2,930 laborers, with their wives and families, have been brought from Porto Rico, besides the introduction of 19 negroes from the Southern States, 76 Italians, and 105 Portuguese; and a number of negroes has also been obtained by one of the local firms.

The experiment of bringing such negro laborers did not prove successful, and no further attempts in that direction were made. The Italians, though few in number, have thus far proven satisfactory.

The crops harvested for the year ending September 30, 1901, have yielded well, amounting in all to 360,038 tons.

The Experimental Station has been maintained and efficiently conducted during the past year. Mr. Blouin, the Director, has done very efficient work. Owing to illness, Mr. Blouin resigned in August of this year, and Mr. Eckart has been placed in charge pending the appointment of his successor.

The expense of maintaining the station is considerable, but there seems to be no question as to the value of the experiments made and work done.

A meeting of delegates from all the Islands was held in August of this year, and the results of the meeting have tended to establish co-operation and better understanding among the managers. Such meetings will be held every three months in Honolulu.

ROYAL D. MEAD,
Acting Secretary H. S. P. A.

Honolulu, November 18, 1901.

EXPERIMENT STATION AND LABORATORIES OF THE HAWAIIAN SUGAR PLANTERS' ASSOCIATION.

HONOLULU, H. T., Nov. 1, 1901.

GENTLEMEN:—Your committee on the Experiment Station beg to submit the following report:

During the last part of 1900, a suitable building was erected on the grounds of the Experiment Station and thoroughly equipped under the direction of Mr. R. E. Blouin, for the execution of all kinds of chemical work. As regards size and arrangement this laboratory has many advantages over the quarters formerly occupied on Nuuanu street and investigations of a chemical nature have been greatly facilitated. The nature and amount of work performed during the past year is shown in the following summary:

LABORATORY WORK.—Samples analyzed for plantations:

1—Soils—Agricultural Method	9
Aspartic Acid Method	50
2—Fertilizers	189
3—Sugars	6
4—Cane juices	6
5—Syrups and Molasses	4
6—Waters	12
Total	276

Samples analyzed for Experiment Station:

1—Soils	24
2—Fertilizers	15
3—Cane—Organic matter, nitrogen and ash	40
4—Juice	49
5—Cane ash—Partial analyses	32
Complete analyses	8
Total	168
Miscellaneous samples analyzed	5
Total number of samples analyzed	449

The number of fertilizer samples received by the laboratory for analysis has been more than double the number received during the previous year. Allowing a margin of 0.3 of one per cent for each ingredient, a comparison of the analytical results of the laboratory with the guarantees of manufacturers would indicate a shortage equivalent to about $11,000. It was estimated last year that the deficit was in the neighborhood of $12,000, the calculation being based on less than one-half of the number of fertilizers that have been analyzed this year. This would indicate an improvement in the quality of fertilizers that have been put on the market with guarantees.

FIELD WORK.—Tests are being conducted with the ratoons from the varieties of cane planted in June, 1898. Of the thirteen varieties originally planted and which were discussed at some length in the report of the Experiment Station for 1900, three have been omitted from the stubble tests. The Rose Bamboo ratoons were cut for seed and the Fiji Purple and Demerara No. 124 varieties were cut back on account of rust following the rains of last winter.

Plant cane tests were started in August, 1900, with Demerara No. 74, Dem. No. 69, Sacuri, Otaheite, Salangore and

White Bamboo. Of these varieties, Dem. No. 69, Sacuri, Otaheite, and Salangore were cut back last December owing to rust, leaving Dem. No. 74 and White Bamboo to be taken off in April or May, 1902, and compared with tests reported at the last meeting of the Association.

The following varieties have been planted during the past year to be taken off in 1901: Cavengerie, Gee Gow, Bangan, Badilla, Sacuri, Otaheite, Salangore, Tibboo Mird, La. Striped, La. Purple, Striped Singapore, Big Ribbon, White Bamboo, Yellow Caledonia, Yellow Bamboo, Demerara No. 117, Demerara No. 95, Demerara No. 74, Demerara No. 69, Queensland No. 1, Queensland No. 3, Queensland No. 4, Queensland No. 6, Queensland No. 7, Queensland No. 8A, Queensland No. 9.

New varieties which are being grown for seed cane are: Rappoe, Dark Bamboo, Daniel Dupont, and Big Tana.

For the new varieties which have been received during the past year, the Experiment station is indebted to R. E. Blouin, A. Koebele, E. Hartman and W. C. Stubbs.

The planting tests, started on June 27th-29th, 1900, by Dr. Maxwell will not mature until April or May, 1902, when the results will be compared with the old series of tests reported in last year's statement. These experiments were started to observe the results of planting eyes at varying distances from each other, and to note the effect of using different quantities of seed in the row. Lahaina and Rose Bamboo canes will be compared in these tests, the manner of planting being as follows:

Two continuous canes in row.
One continuous cane in row.
One eye per 6 inches.
One eye per 12 inches.
One eye per 18 inches.

On July 27th of this year six rows of Lahaina cane were planted by Mr. Blouin to observe the effects of stripping. These experiments will be treated in the following manner:

No stripping.
One stripping in May, 1901.
Two strippings, one in March, the other in Oct. 1902.
Three strippings, one in March, one in Aug. and one in Nov., 1902.

A series of irrigation experiments are in progress, the object being to note the effect of different volumes of water applied at varying intervals. These tests were started in June of this year by Mr. Blouin, and are as follows:

4 rows are receiving three inches of water per week.
3 rows, 2 inches per week.
3 rows, 1 inch per week.
3 rows, 3 inches every three weeks.
3 rows, 2 inches every 2 weeks.

These experiments are being conducted with both Lahaina and Rose Bamboo varieties.

Another series of irrigation tests to observe the action of salt on cane are being undertaken in another part of the field. These are divided into four plats, and are irrigated with water containing 50, 100, 150 and 200 grains each of salt per U. S. gallon.

A plat of Rose Bamboo and another of Lahaina cane were planted in the latter part of last February to be taken off in February, 1902, the object of the experiment being to note the yield of sugar in the respective varieties after one year's growth.

Twenty-six plats are devoted to a study of fertilizers and cover a variety of tests. Through the application of varying quantities of the different fertilizer ingredients results will be reached to indicate the most suitable forms and economical mixtures. These experiments will also involve a laboratory study as to the amounts of the elements that have been taken up by the cane on the various plats.

During the past year quantities of seed cane representing eleven varieties were distributed among about thirty plantations, following a circular letter addressed to plantation managers in regard to results of varieties tests.

Respectfully submitted,

C. F. Eckart,
J. P. Cooke,
W. M. Giffard,
Aug. Ahrens.

The reading of reports of committees being next in order, that of Handling of Cane was read as follows:

REPORT ON HANDLING AND TRANSPORTATION OF CANE.

As chairman of the committee on Handling and Transportation of Cane I beg to offer the following: I have been assisted by Mr. John T. Moir of Onomea Sugar Co. and Mr. John M. Horner of Kukaiau Plantation Co., of the Island of Hawaii, and Mr. George R. Ewart of Kilauea Plantation Co., of the Island of Kauai, members of the committee. I shall undertake to quote some of the statements and figures given to me by Messrs. Moir and Ewart. Mr. Horner's communication I give in full, the subject being most familiar to him and the information on the overhead wire rope tramway being of special interest to many of us at this time.

The question of transportation of cane has often been written on and discussed in numerous articles by many different members of the Association, and there is little that can be added. The advances in the past few years have been few. The reports go to show that practically little or no improvements have been made over old methods, and at this time so far as I can see the methods in vogue 18 years ago on the larger estates are still in use. The average cost per ton of sugar manufactured, for the handling, loading and transporting of cane, including all outlays, is shown to have ranged on on the different plantations from $3.50 to $5.50 per ton for the past 8 or 10 years, the extreme cost being $8.00 per ton of sugar and the minimum cost $3.00 per ton of sugar. The question of handling and transportation of cane today is of considerable importance to many of the plantations. Many of the mills are of such a capacity that will permit of the handling for manufacture of greater quantities of cane than can be furnished, due to the stringent conditions that are accounted for in connection with labor in many ways. Hence the importance of this branch of the work has of late been much impressed upon the planters, because of the expense which ensues through not being able to keep the mill properly supplied.

With the advance in the cost of labor and the independent and more stringent labor conditions, plantations having methods for the handling and transportation of cane where they depend for the economical outlay of the work on the low cost of manual labor now must devise new means. The advantages which plantations have had, having level and easy sloping lands where the work has been done by railroad system, loading in cars on portable tracks, in the past years over those plantations that have had the question to deal with in years gone by because of a rougher contour and more broken condition of their respective places, are now put on the same footing and confronted more forceably with the problem. The labor problem not being a point of consideration at that time they were able to perform the work by manual labor entirely at figures that would compete with conditions and methods or systems requiring less manual labor, having more mechanical devices in their use. It was apparent to the writer during the past season that much of the manual labor could be replaced with mule labor by adopting for the hilly lands methods in use on plantations having similar conditions. Therefore the subject becomes one of our important branches of the industry, and while not only because of the advance in labor but because of reluctance of laborers to perform the class of work which comes under the head of handling cane, more commonly known as "Hapai Ko." It is not to be wondered at when we consider the locomotive power that the laborer expends in packing and elevating of cane in this work, whether on cars or wagons, which is hereafter so plainly pictured by Mr. Horner.

The modes of the transportation of cane are by permanent and portable railroads, over which the cars are hauled by steam and mule power, permanent and portable flumes, mule carts and wagons, and the wire rope tramway. Where water can be obtained for fluming cane in supply sufficient to warrant the transportation to the mill, main and portable flumes are in use. Where the lands are of a level nature or of easy slopes the railroad system is generally in use, and where the contour of the estates is more broken and hilly the methods of transportation are varied, sometimes including two or more ways of transportation of cane.

On Onomea Plantation, on Hawaii, the flume system is in vogue. The cane is tied up in small bundles from 60 to 80 lbs. each and carried a distance from 100 to 150 feet to a flume side. Out of the way corners and sides of palis, gulleys and more distant parts of the fields, the cane is hauled by sleds. Sleds are used because of the cane being easily handled in loading and unloading of the same. Considerable labor is used in the piling of the cane at the flume sides for night work. 1x14 inch pine lumber is used in 12-foot length flume boxes for portable flumes, thus in removing the flumes one man is able to pack one section very readily. Cane is flumed in this manner through portable and permanent flumes on this plantation over a distance of 7 miles. The cost for the handling, loading, transporting, and every outlay connected with the fluming of cane, including the expense of the animals hauling sleds and carts and the expense of guarding and superintending the flumes, placing and building of portable flumes, is shown by Mr. Moir to be approximately 60c per ton of cane or $4.80 per ton of sugar, delivered in the carrier at the mill.

At the Kukaiau Plantation a wire cable system is used, the cane being loaded into wagons especially designed after which it is hauled to the wire cable. No definite figures of cost are given by Mr. John M. Horner, but the subject and methods are treated most fully in his writing. He refers to Mr. Albert Horner for details and from him the following information has indirectly come to me. The cost at the Kukaiau Plantation for the cutting and bundling of cane approximates between 30 and 35c per ton and further handling and transportation of same some 27c per ton. This would make a total outlay of about 60c per ton including the cost of cutting. Taking the average cost of cutting cane throughout the islands for the past season at about 22c per ton, we might say a figure of 38c per ton for the bundling, handling and transportation of the same by the wire cable system was the cost. This figure of 38c per ton by 8 tons of cane to a ton of sugar would equal $3.04 per ton of sugar. These figures however are approximate and probably do not include the cost of wear and tear and up-keep of the system. In studying this system and looking at it from an economical standpoint, even though these figures were increased some, it is not the only point of interest to us, there is still another that is just as vital; that of minimizing the manual labor necessary for harvesting a crop by this system. I have not been able to secure this information, but in a general way I am told that it takes less manual labor per ton of cane than by the methods in vogue on the larger estates. In fact by referring to Mr. Horner's writing given below, and following his description of their experience, he states that they found one sled, two mules and two men took the place of 14 men. He goes on and shows further that they made still further cuts in necessary quantity of manual labor. Hence the team of mules actually took the place of 12 laborers. This is the particular point of interest to the writer, for it shows that by increasing the mule labor 20 per cent the manual labor was reduced over eighty per cent.

The cost of handling and transportation of cane on the Island of Kauai, at the Kilauea Plantation, as reported to me by Mr. Ewart, includes all outlays which appertain to the loading of cane, the laying of portable tracks, the hauling of cane and cars on both the main and portable tracks, the cost of fuel, oil, waste and repairs and up-keep of main line, of 45c per ton of cane or $4.46 per ton of sugar. The longest haul on the main track was 6 miles; the longest haul on portable track was 1¾ miles; the average haul on portable track being ¾ of a mile, and the average haul on rail line by locomotive 2 miles. The loading of cane was done by contract, with an average outlay of about 19c per ton including bonuses. Mr. Ewart shows in his figures that they have been enabled to keep the contractors up to the mark and compel them to do good clean work in loading, and also to do this work without in any way reducing long established rules for the distance which portable tracks were laid apart. He mentions the fact that was observed in nearly all of the plantations on this island where cane loading was done under contract, that of the average tonnage loaded on the cars being considerably less than formerly.

The cost for handling and transportation of cane by system of permanent and portable track on the Honolulu Plantation and in fact on all the plantations on this island, has been practically of the same proportions as the figures which Mr. Ewart shows. The system in vogue is exactly similar to that of Kilauea Plantation on Kauai, the transportation being by mule power on portable track and steam power on the main or permanent lines, the loading being done under contract at an average of 26c per ton of cane as against an outlay by Mr. Ewart of 19c per ton of cane. I have been able to gather from the figures of the work performed on this plantation and that of adjoining plantations that the average cost for the handling and transportation of cane from the fields of the upper lands where the contour of the country is more broken averaged as high as 65c per ton of cane or $5.50 per ton of sugar.

The foregoing figures include not only the cost of handling, loading and transportation of cane but also the cost of the up-keep and repairs of the track, both main and portable, meaning every expense connected with the handling and transportation of the cane, inclusive of oils, waste, fuel and supplies necessary.

Like Mr. Horner I am an advocate of less manual labor and more mule power. Being awake to the necessity of labor-saving devices for the harvesting of our rougher high lands we used the derrick and hauled most of the cane by sleds from the more inconvenient places, cutting out over 80 per cent of portable track work and reducing the manual labor some 40 per cent, increasing the mule labor 25 per cent, and reduced the actual cost of loading and transportation of cane from such lands by this method to from 50 to 54c per ton including all items of up-keep of track, locomotive expense, etc. We devised an automatic sling to avoid trouble with sling ropes and delays in bundling which greatly increased the efficiency of the system. Each sled had its sling and around each derrick there was always one or two extras so as not to detain the mule teams. The sling was laid loosely inside of the box-sled and cane piled in on top. At the derrick a man, boy and mule were required. It operates like a derrick hay-fork and parts in the middle by the pulling of a trigger when the load is swung over the car by the jib of the crane. In doing this work we experimented on the length of haul and found that from 800 to 1,000 feet was the limit. When making longer hauls the cost increased; beyond this, requiring more mule teams or permitting a waiting spell by the loaders of the sleds. While this was a saving of from 20 to 25 per cent on these lands in expense we do not think the same ratio of gain would accrue from this method on the level laying fields, as we were assisted by gravity, the derrick always being placed so we hauled down hill. However the special point of interest to us was that we made a saving of manual labor of 50 per cent, and even if we were not enabled to reduce the cost of loading and handling of cane by this method on more level laying fields we would reduce the manual labor.

It is the writer's idea however that a machine other than the derrick system, of a much greater labor saving efficiency for the more level fields, will be devised. We found one advantage of loading in box-sleds, which were driven between the rows of cane evenly piled by the cutters; this was in the nature of the work, being so light that we employed all classes of labor, including women, and being done under day wage we were enabled to do clean work, which was not the case when the work was done under the contract system, for the stringent conditions of labor would not permit of it. We were not satisfied with our derrick, the guying of same when on steep palis sometimes giving trouble and delaying work when moving about. We have ordered from Fowler & Co., Leeds, London, a portable crane which can be put on a wagon of cane car, being a goose-neck arrangement, total weight, including car or wagon 3,000 to 4,000 lbs. The frame is of iron with extension bars running out from the sides, acting as outriggers and setting on blocks. The jib swings a complete circle to a radius of 10 feet, lifts 1,000 lbs., the requisite height giving plenty of clearance. It has a cast iron weight which moves on the tail-bars of the goose-neck shaped crane to counter-balance the combined jib and crane, thus requiring no guy-lines. The crane is also fitted with automatic friction crab, self-acting brake and all up-to-date necessary hoisting and lowering devices. The portable nature of this will permit of it being moved about without unnecessary preparation.

The conditions therefore that have existed for the past two years have brought about a desire for improvement in the methods of handling and loading of cane, and to 50 per cent of the plantations on these islands this has been emphasized during the past season. No cane planter can afford to neglect any source of information or ideas that will throw new light or will tend to improve the methods of handling and loading of cane. The rewards and bonuses offered by the Association have induced many persons to devise, build, and give much time and attention to various cane loading machines. Some of the apparatus of which models have been made do not in any way cover the requirements. Many of the machines are repetitions of old established methods and but few new ideas have come forward of any value. Some two years past cane harvesting machines, combined cutting and loading apparatus, were talked of and written of, but today it is practically conceded that no apparatus of this nature can be devised to fulfill the requirements, and the whole center of discussion and thought has been towards the devising of cane loading machines. Those machines that have come to the writer's notice have been in the nature of derricks or cane carrier apparatus, and in fact all of the machines that have been devised, either on paper or in model, are of this nature. All of the machines require that the cane be lifted by the laborer and placed either on carriers or in baskets, tables or containers which are lowered and elevated. No machine has yet been devised or modelled which avoids the handling of cane by hand labor. In nearly every instance the apparatus that have been constructed up to the present time are of too heavy and massive a nature.

Most all of the loading apparatus and machines, of which there are now many models and drawings, have steam and gasoline power attachments, which are serious objections to the devices because of the increased liability of fire in cane fields. Nearly all designers of loading machines seem to lose sight of the practical side in the complete labor saving portion of the question. The whole aim with them seems to have been in every case to devise a machine that would elevate and drop the cane into a wagon or car. Little or no thought or study has been in the direction of designing an apparatus which will pick the cane up from the ground without the assistance of manual labor. Nearly all the machines and devices planned for the handling and loading of cane will be limited to conditions that are not always obtained, and in fact I might say no plantation presents the complete conditions for the successful working of machines that has yet come to our notice. The principle to be worked for is to avoid the handling of the cane by manual labor. If the cane is to be handled, bundled, and picked up from the ground, more especially from the steeper and more hilly lands, the system of sleds for conveying to the cars on portable tracks or wire cable and the crane for elevating can not be surpassed. The ideal machine is one that will pick the cane from the ground.

A number of models for the handling of cane that have been shown to the writer are most worthy of consideration, and I believe that the inventors and designers will profit materially by straightforward criticisms, and suggestions will necessarily come that will help along the cause, so I have invited the exhibition of drawings and models.

Respectfully submitted,

James A, Low,
Chairman Committee H. & T. of Cane.

Geo. R. Ewart,
Member.

John T. Moir,
Member.

Mr. James A. Low, Chairman of Committee on Handling and Transportation of cane.

Dear Sir:—I forward the following:

HANDLING AND TRANSPORTATION OF CANE.

This is comparatively an old subject. It has been evolved in many brains by intelligent, practical men in these islands over 20 years and many scores of years in other parts of the world. Improvements have been made from time to time and new methods suggested and tried. Some adopted, some rejected. Not being posted in the many detail methods of handling cane on many plantations the past few years; we can only refer to our own method of handling cane and how we have seen others do it. Carts, flumes, railroads and the wire trolley system are our present methods of cane transportation on these islands. All of these methods have been well tested by actual use except the wire trolley system. This is the newest method of transporting cane with which we are acquainted and as we have had considerable experience in its use perhaps we should briefly notice it. It has been longest used on Kukaiau Plantation than upon any other; in fact it was first used there for transporting cane. There we had no railroads or flumes. We got along fairly well delivering cane to the works with teams while we were raising cane near the mill, but when we extended our cultivation into distant fields beyond the gulches we encountered loss and hard work, particularly so in rainy times. There were still beyond several hundred acres of good cane land so far away it would not pay to cultivate if the cane had to be transported to the mill by mule and horse teams. So, much thought was given to transportation. Finally we heard that coal, ore, wood and other things were being transported by a wire cable system over a rough country where no other known contrivance would or could work. So we decided to try 1,000 feet of cable. Our ignorance made bungling work of it at the start, but we thought ourselves quite successful in its trial. Some practical men came to see it work and encouragingly declared: "If it worked 1,000 feet it would work 10,000 or any distance." We believing the same ordered for our next crop cables of sufficient length to land our most distant cane at the works without further handling. We gradually learned how to use it and are now able to transport on the wire all our cane grown above the works. We were much encouraged when we were able to send down from our most distant field ten clarifiers per day. Now double that amount is our smallest day's work and on our most favorable lines four clarifiers per hour is not unusual to be transported by one cable.

Comparisons as to the efficiency and cheapness of the different methods of cane transportation is hardly worth naming, as all plantations differ in the lay of their lands, the location of their works. A deficiency of water and other causes forces some plantations to adopt one method and others another method. Some plantations combine two of the above methods to good advantage. Where a railroad runs along the lower part of the plantation to the works the cane from all parts of the plantation can be dropped into the cars from a wire cable, or from a flume if water is available. This is all that seems prudent to say at this time upon cane transportation. Now comes

CANE HANDLING.

"Cane handling" I presume is intended to include all labor required to move the cane after it is cut, to, and place it in cars, wagons, flumes and upon the wire cables, which convey it to the works.

This is done altogether by man or horse power. We have had some experience loading cane upon cars, wagons, flumes and the wire cable. We have heard complaints about the hard and costly work, loading cane on cars, wagons, wire cables, and packing cane to flumes. At our last year's meeting considerable was said about the hard work complained of.

in loading cane cars, almost impossible to have it done save by contract. Not having any hard work complained of in loading cane cars on our island we said nothing, believing as we did that the large plantations where irrigation was used, more rapid work was required and a different method had been adopted than any we were acquainted with. We knew nothing to the contrary until we received a picture showing how they load sugar cane on cars in these islands. If the picture shows truly, the cane is loaded upon the cars by being packed on the shoulders of men, who walk up a plank and drop it on the car. This is indeed hard work. The man weighing 150 lbs. taking up a 50 lb. bundle of cane; in reality he takes up 200 lbs. including his own weight, drops 50 lbs. on the car and returns with 150. If this is kept up all day he possibly loads 10 tons of cane, and in so doing he has taken up 40 tons of matter, left the 10 tons of cane, and returned 30 tons to the starting point, and travelled while doing it from 5 miles to 10, depending upon how far the cane is from the car. This may truly be reckoned hard work.

We pursued a different method of loading cars with cane 18 years ago, and presume it is used to a slight extent yet. We loaded the cane upon sleds in the field where it was, drove the team by the side of the car and hoisted the cane upon the car by a horse, 800 lbs. or more at a lift. There was no hard work for man or horse by this method. The horse did the packing from the field and the lifting at the car. The expense for loading one ton of cane was near 10c with no hard work for man or beast. When we commenced experimenting with the trolley system, the cane was packed and hung on the wire by the men in 100 lb. bundles. This was slow, costly and hard work. As our knowledge of working the wire increased more cane was required, so we added the sled. One sled, two horses and driver would take as much cane to the wire at one time as 14 men. This eliminated all hard work save to lift the bundles onto the sleds. Even that was not onerous as the bundles were yet light.

Having improvement on the brain, and sleds heavy to haul, we tried a low-wheeled wagon. This proved a big improvement as it doubled the efficiency of the team and its driver, so we dropped the sleds, using only the wagons. After deciding just what kind of a wagon was best for the purpose we ordered six from San Francisco. They are now here and up to requirements. As the hard work of cane packing was now over we increased the weight of the bundles gradually to 125, 150, 200 and 250 lbs. The advantage of sending down large bundles is, there are not so many trolleys to pack back, and a 300 lb. bundle is no more likely to meet with an accident on its way down than a 100 lb. bundle. When we adopted the 250 lb. bundle we ran against a snag as the bundles were now too heavy for two men to lift upon the wagon. Objections were honestly made by the workmen against the weight and some of the laborers threatened to leave rather than continue to lift such heavy weight. Being thus brought to a sudden stop, so far as increasing the weight of bundles was concerned, and the prospect of being forced back to the 200 lb. bundle produced in us serious thought. This forced the invention of a travelling crane for lifting the bundles onto the wagons. It is pushed about the field by two horses and guided by one man to any point the wagon stops for a load. Six men and two horses now load the wagons with any weight of bundle up to 350 lbs. This has eliminated all heavy lifting loading the wagons and they are more rapidly loaded than twelve men formerly did it, and they then worked hard.

The next point requiring improvement was changing the cane from the wagon to the cable. It took now too many men. So we constructed a contrivance to hoist the bundles from the wagon, and operated it by a horse. Adding the horse displaced four men. This improvement has proved very satisfactory, requiring less labor and doing more rapid work. This trolley system is more easily changed from one field to another than flumes or railroads. It works equally well in wet or dry weather, with water or without. A rough country only requires sufficient grade to work the system effectually over it.

Our Mr. Albert Horner, who has been the principal actor in working up this system is getting up a pamphlet from which more information about it may be gathered than is here stated.

JNO. M. HORNER.

REPORT OF COMMITTEE ON MACHINERY.

GENTLEMEN:—This committee fully realizes that it is appointed for the purpose of laying before you a report on machinery, that is, a description of new machinery installations in the various Hawaiian sugar houses, a criticism of the comparative value of the different styles of machinery installed for the same purposes, and to establish some conclusive results based upon carefully conducted investigations and experiments.

We are of the opinion that the work of a committee appointed for these purposes, could be of value to many plantation managers. We regret, however, that the appointment of this committee took place so late—September 9th—that no advantage could be taken of the last grinding season to establish independent investigations and necessary experiments and tests. It has also been impossible to get the members together for the purpose of a general discussion of the various items under consideration. As it is, however, we have endeavored to gather some data which we think will be of interest to you, and will submit them as individual contributions to this report.

Exhibits 1.—Description of Machinery, and result of experiments with bagasse burning furnace at Honolulu Sugar Co., by Mr. James A. Low.

2.—Paper by Mr. W. W. Goodale on Waialua Mill.

3.—Description of the McBryde Sugar Co.'s new sugar house, by Mr. W. Stodart.

4.—Description of "Puunene" Mill—Hawaiian Commercial & Sugar Co., by Mr. C. Hedemann.

5.—Description of Olaa Sugar Co.'s Mill, by Mr. C. Hedemann.

6.—Description of the re-constructed Ewa Mill by Mr. C. Hedemann.

7.—Description of Puako Mill by Mr. C. Hedemann.

8.—Paper on Mill Extraction, by Mr. C. Hedemann.

9.—Paper on Sand Filters, by Mr. C. Hedemann.

10—Paper on Centrifugal Work, by Mr. C. Hedemann.

11.—Paper on Sugar Drying Machinery, by Mr. John Hind.

12.—Paper on "Lillie" Evaporator and Wick's Cane Unloader, by Mr. John Watt.

13.—Paper on Crystallization in Motion, machinery used and modus operandi, by Mr. P. A. G. Messchaert.

Respectfully submitted,

C. Hedemann, Chairman.

Mr. C. Hedemann, Chairman Committee on Machinery, Hawaiian Sugar Planters' Association.

Dear Sir:—As a member of the Committee on Machinery, I doubt whether I can give any information that would be of interest, unless I detail what we have in our mill and some of our experiences during the past season. The machinery installed in our mill is similar to what is installed in most of the new and larger mills. The Gregg Unloading Apparatus is a portion of our machinery and works satisfactorily.

Crushing Apparatus.—The crushing apparatus consists of a Fulton Iron Works nine-roller mill and two-roller crusher, all connected to one common gearing driven by one main engine of the Corliss type, 28x60 inches. This engines does the work, developing 265 indicated horse-power with 115 lbs. gauge pressure and 5 lbs. back pressure. The rollers of the mill are 34x78 inches and of the crusher 32x78 inches. We have found that this mill will grind from 50 to 54 tons of cane per hour and maintain a high standard of extraction. During the past season, we have carried a constant hydraulic pressure of 260 tons on the crusher, 340 tons on the first set of rolls, 360 tons on the second set of rolls, and 380 tons minimum and 420 tons maximum on the last set of rolls. An average dilution of 13% gave an average extraction of 93.74% of total sugar in cane and 82.37% of weight of cane. The mode of arriving at these results is figured by weight of cane and on sucrose in cane. The direct connected crusher is a very desirable arrangement. The mill worked with complete satisfaction.

Boiler Plant.—Our boiler plant consists of six 250 horse-power Heine Water-Tube Boilers, each of 1,804 square feet of heating surface and 40 square feet of grate surface, and working at 125 lbs. steam pressure. The boiler settings consisted of a furnace constructed with an immense brick arch running under the bottom tubes of the boilers to within 36 inches of the rear water leg. In a boiler setting for coal burning, this arch is not called for, but instead a course of tile is placed between the bottom and second row of tubes. We have both the Heine and the Babcock & Wilcox water-tube boilers installed in our pumping plants. We saw no reason why these trash furnaces should not be arranged similar to coal burning furnaces. We were forced to study the furnace question in connection with our boiler plant in the mill because of our being obliged to burn outside fuel in two furnaces in order to supply sufficient steam for our boiling house. The tests were made with bagasse coming from the mill which showed an average moisture of 38% and which contained from 3½ to 4½% of sucrose.

The original boiler setting as installed was tested, and is enumerated in the list hereafter detailed as test No. 2, showing an evaporation of water from and at 212° Fahr. of 1.78 lbs. per lb. of bagasse. While there is but one record in this list of the original setting, we made other tests with little or no varying results before concluding on alterations. It will be seen that the first test made, enumerated No. 1, was on the first alteration, and the result as compared with the old setting in test No. 2, showed a gain of over 80%. This was so encouraging that we immediately followed up with further tests with the idea of ascertaining the proper area of grate surface for the heating surface, as well as to ascertain the height of the bridge wall in connection with the combustion chamber. We first reduced the grate surface and then again increased the grate surface, finally coming back to the original width, but increasing the space between the bridge wall and lower row of tubes to a height of 30 inches. This resulted in an evaporation of water from and at 212° Fahr. of 3.34 lbs. of water per lb. of fuel, or an increase of 87% over the work first performed. Here follows data on the boiler tests. These tests were made very carefully and can be vouched for. Our whole boiler plant was immediately re-arranged. We were enabled thereby to get along from that time on without the assistance of outside fuel, running on five boilers only and leaving one as a spare, and accumulating fuel.

TESTS	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9
Lbs. fuel (bagasse) used during test...	2000	2000	2000	2 00	2000	2000	2000	2000	2000
Lbs. of water evaporated during test..	5375	3000	5062½	4250	2250	3625	5625	4000	3187
Temp. of water in degrees Fahr.......	76	76	79	79	79	75.5	75 5	75.5	76
Temp. in breeching degrees Fahr......	500	545	....	.....	....	500	509	500	......
Steam pessure in lbs.	125	120	120	120	120	122	118	118	114.5
Evaporated (actual) of water in lbs........	2.68	1.50	2.531	2.125	1.125	1.812	2 812	2.00	1.555
Evap. of water from and at 212 degrees Fahr.............	3.19	1.78	2.989	2.509	1.329	2.153	3.339	2.375	1.844
Duration of test in minutes...........	....	....		.....	....	30	40	35	20

When the whole plant is working, the temperature runs up to about 700° Fahr. in the breeching, which illustrates the possible economy by addition of superheaters.

Evaporative Boiler Tests.—Original brick setting had an arch over furnace and combustion chamber extending from front of boiler to within 36 inches of back end of boiler. Bridge wall had an opening 20 inches high. Furnace original width 60 inches.

No tiles were placed on bottom of tubes. Opening to flue at upper tiles was 36 inches long.

Test No. 1.—May 26th, 1901. Was made with the following alterations to brick setting:

Arch over furnace and combustion chamber removed. Tiles put on bottom row of tubes with an opening at end of tiles 36 inches long.

Opening at end of tiles upper row reduced to 30 inches long.
Bridge wall was altered to 24 inches high from tubes.
Furnace was left original width or 60 inches.

Test No. 2.—May 26, 1901. This test was made with furnace arranged as follows, being original setting:

Original arch over furnace and combustion chamber was left in place.

Bridge wall was not altered from 20 inches high from bottom of arch; opening at end of upper tiles—36 inches long.
Furnace was left at original width—60 inches.
No tiles were placed on bottom row of tubes.

Test No. 3.—June 2nd, 1901. Made with arch over furnace and combustion chamber removed.

Tiles on bottom row of tubes with opening 36 inches long.

Tiles on top row of tubes with opening 24 inches long.

Bridge wall 24 inches high from bottom of tubes.

Furnace left original width—60 inches.

Test No. 4.—June 2nd, 1901. Made without arch over furnace and combustion chamber. Tiles on tubes and bridge wall same as in No. 3 test. Furnace reduced to 55 inches wide —a reduction of 8 1-3%.

Test No. 5.—June 2nd, 1901. Arch over furnace and combustion chamber removed. Tiles on tubes and bridge wall same as in No. 3 test.

Furnace reduced to 50 inches wide—a reduction of 16 2-3%.

Test No. 6.—July 21st, 1901. Arch over furnace and combustion chamber removed. Tiles on tubes same as in No. 3 test.

Bridge 30 inches high from bottom of tubes. Furnace increased to 72 inches wide.

Test No. 7.—July 21st, 1901. Arch over furnace and combustion chamber removed. Tiles on tubes same as in No. 3 test.

Bridge wall 30 inches high from bottom of tubes.

Furnace original width—60 inches.

Test No. 8.—July 21st, 1901. Arch over furnace and combustion chamber removed.

Tiles on tubes same as in No. 3 test.

Bridge wall 24 inches high from bottom of tubes.

Furnace original with—60 inches.

Test No. 9.—July 28th., 1901. Arch over furnace and combustion chamber removed.

Tiles on tubes same as in No. 3 test.

Bridge wall 30 inches high from bottom of tubes.

Furnace 67 inches wide or an increase of 7 inches over original width.

In our boiling house we have the Deming Clarifying System, with large round lime tempering tanks, and instead of the continuous settlers, we have 22 square settling tanks of 800 gallons capacity each. This Deming is constructed with the pipe absorber arrangement instead of the cylinder absorber.

"LILLIE" EVAPORATOR AND KILBY VACUUM PANS.—We have the Lillie Evaporator and the Kilby Vacuum Pans. We have three vacuum pans with a capacity of 20 tons sugar each, 10 feet 6 inches diameter, and we are having the Kilby Manufacturing Co. make for us a larger pan, of 13 foot diameter, striking about 35 tons.

We have 20 crystallizers of the Dr. Boch style, with a total capacity of 12,000 cubic feet; and sixteen 42-inch Watson-Laidlaw Water-Driven Centrifugals, the power for same being furnished by two single flywheel Corliss valve gear hydraulic pumps of the Risdon Iron Works' make. The flywheel pumps permitted of a pressure on the discharge from the same, which furnished the power for the centrifugals, of from 180 to 200 lbs. This enabled us to run the centrifugals to between 1,050 and 1,100 revolutions per minute and thereby permitting good work in the drying of the sugars. We were contemplating the addition of sugar dryers, but the high velocity at which we were enabled to run the centrifugals through the even pressure from the flywheel pumps gave such satisfaction in the drying of the sugars in the machines that we abandoned the idea of installing sugar dryers.

The Lillie Quadruple Evaporator Apparatus, like most of the machinery installed in this mill, is also in use in many of the new mills. It has advantages and disadvantages over the old standard type of multiple effect. No doubt the film evaporator is a great advance in evaporation, and certainly there can not be anything said against the system, nor against the automatic work of it. The inventor's claim, however, on the point of entrainment is certainly very much stretched. The entrainment at times is very serious and the whole effect in this respect is so arranged that it requires ever constant attention. We were enabled to get the maximum duty from our apparatus when the juice was of a very high purity and most thoroughly settled. I believe, however, that the difficulties can all be remedied, and in this mill we are contemplating the elevating of the vapor pipes and the addition of one or two more baffle plates, especially in the first two bodies. The average entrainment of the apparatus when working at a steam pressure of from 3 to 3½ lbs. in the first effect was .001 to .01 of one per cent, as against when working at a steam pressure of 5 lbs. in the first effect, this being the requirements under the guarantee of the Lillie apparatus people, the entrainment rose to .025 to .03 of one per cent in the waste waters. Our average, however, for the season has been about .03.

There are a number of minor changes that could easily be made in the apparatus and make the same very much more practical, the principal one being a change in the arrangement of the heating tubes as respects the removal of the same, the present arrangement being a head into which the tubes are rolled and expanded, making it a permanent connection, and almost impossible to remove a tube without destroying it. With the change in the manner of supporting these tubes in the head, when the tubes become coated, which is the principal trouble and cause of the slow evaporation, and upon which soda and acid solutions were ineffective in the cleaning process, they could at any time be easily replaced with an extra set, allowing ample time to clean the tubes removed. We figure that the work of replacing the tubes in a whole body could easily be done in 24 hours. Very often a portion of the tubes are in a splendid condition while there are rows that are very heavily coated. We have found the acids in the work of cleaning very disastrous and during the latter part of the season abandoned the use of the same.

There are some minor changes which could be made. For instance the swinging of the front doors on hinges as in the case of the back doors, and the replacing of the Westinghouse engine with some marine style of high speed vertical engine. The Westinghouse standard engine which has been supplied with the effect has been troublesome. The steam leaked past the piston and piston rings and the oil crawled up through the cylinder past the pistons into the exhaust. When these troubles were located in the engine, we took off the door of the first effect, believing that perhaps the tubes were coated with oil, but found no evidence of such a state of affairs, and the door was replaced and the work continued until the end of the season. When again removing the doors, we found that the oil from the exhaust instead of coating the tubes in the first effect had passed by it and gone to the second and third effect, especially the third effect, all the tubes of which were heavily coated with oil. With this season, we intend leading the exhaust away. The steam passing through heated up the oils and crank shaft, causing trouble by the melting out of the babbitt, as well as a great loss of oil and steam. For an engine performing the nature of work which is performed by this engine, the machinery should be of a type where the working parts are always exposed and which would permit of quickly repairing the same without extended shutdowns, as is necessary with this type of engine because of the heated condition of the parts. We found the claim Mr. Lillie made in the advantage of keeping the tubes clean by the reversing of the working of the apparatus faulty. There is no advantage in this whatever, because of the retarding of the evaporation, the thinnest juices where the greatest evaporation should take place being in the coldest vessel. We look forward, however, to very much more satisfactory work durnig the next season as we are adding sand filters to our machinery and by this means will not have to force the apparatus as we have during the past season with our very low juices. The Lillie apparatus as an evaporator on the whole is very satisfactory. We believe the exchange of ideas and comparisons of work performed and an exchange of opinions and experiences of the men working this apparatus in the different sugar mills, will bring it up to a standard that no evaporating apparatus has yet attained. We believe that the condition under which this apparatus has worked during the past season in this mill has been a trying one, but notwithstanding that, we believe that the inventor should plan an apparatus for such conditions, and that there should be margin of heating surface enough to fulfill the guarantees under such conditions, which do not now exist.

Respectfully submitted,

(Signed) JAMES A. LOW,
Member of Committee on Machinery.

C. HEDEMANN, ESQ., Chairman Committee on Sugar Machinery, Hawaiian Planters' Association.

DEAR SIR:—I find it very hard to give you any information regarding such machinery that will be of any value for our report, but send you with this a copy of some figures given to the Fulton Iron Works of St. Louis showing the work done by their mill here, two tests under slightly different conditions. I also send you copy of the tests made with the 40 inch water-driven centrifugals, two tests under different conditions. These speak for themselves.

You are familiar with all the other machinery in our mill, as you were so intimately connected with the buying and installation of it all. I have no figures showing exact results of any of the machinery except the grinding and the centrifugals, or anything that could be used in any way to show the advantages or disadvantages of any of our machinery if placed in competition with machinery manufactured by others.

I would say, however, that we find the Babcock & Wilcox boilers with the extension furnace, most satisfactory, and at times during the past season, when we were grinding cane with juice very low in quality and did not have sufficient trash, we were able to burn coal on the step-ladder grates very successfully, without injury to the furnaces or the grates.

Mr. Deacon, the engineer, is a thorough believer in the Green Economizer.

The Lillie Evaporator has given good satisfaction. Frequent tests for entrainment have been made and we find no appreciable loss.

In the original installation of this mill, we had the Deming Clarifiers and continuous settling tanks, but at the end of the first season, the continuous settling tanks were thrown out, and 20 individual settling tanks of 1,000 gallons capacity each were put in. These gave much better results than the continuous settling tanks. The juice is much brighter and clearer.

We originally installed 8 crystallizers of 6,000 gallons capacity each, and have used them during the last two small crops. We found, however, that we had not crystallizers enough for 24 hours grinding six days in the week, and this year have put in 8 more of about 250 gallons greater capacity each. I have sent to Mr. Olding, chairman of the Committee on Manufacture, a report prepared by our chemist, Mr. Johnson, showing the results from the crystallizers. This is a report on manufacture, pure and simple, but it may be that you will find something of interest in it.

The Kilby Vacuum Pans are doing good work. We have no fault to find with them. Had it not been for the unfortunate start and inability to get suitable vacuum within the first few days grinding, there would never have been anything heard about the Kilby pans.

The Baldwin juice weigher that was installed in this mill we are not using.

The Kilby washing machines for filter press cloth are very satisfactory, but must be run at high speed.

I am very sorry that I cannot give you information of greater value to go in the report, but you understand perfectly well that it is difficult to write anything original on this subject, where exact records are not kept or tests made for the purpose of comparison.

Very truly yours,

WM. W. GOODALE.

BRIEF DESCRIPTION OF THE SUGAR FACTORY ERECTED AT THE McBRYDE PLANTATION, KAUAI.

BUILDINGS.—The buildings are divided into the following departments:

Mill House.
Boiler and Pump House.
Boiling Room.
Pan Room.
Filter Press Room.
Centrifugal and Crystallizer Room.
Sugar Room.
Bagasse Storage Room and Lime House.

CRUSHING PLANT.—The crushing plant consists of three 34x84-inch three-roller mills, fitted with corrugated steel slat intermediate carriers and automatic juice strainer, each carrier being fitted with disconnecting gear. The first and second mills are set 34 feet 6 inches from center to center, the second and third are set 29 feet from center to center. The first three-roller mill is driven by one Corliss engine, 24x28 inches, the second and third three-roller mills (mounted on one bedplate) are driven jointly by one Corliss engine, 28x48 inches. The mill cheeks are made of partial steel. The top roll caps are secured by U bolts and fitted with hydraulics. The introduction of the U bolt enables a very narrow turner bar and plate to be used. The turner bar is of the rocker type and very deep, the trunnions of which stand upon a heavy shelf cast on to lower inside edge of cheeks and fastened to it through slotted holes, by which the clearance of plate is adjusted. This bar requires no openings in cheeks, and cheeks are therefore made solid. The adjustment of the knife to the roll is accomplished from the outside by means of two heavy hook bolts passing through to front of mill on each side.

GEARING.—The gearing is compound mounted on a heavy cast iron frame work with pillow blocks, the frame work being extended up when necessary.

BOILER PLANT.—The boiler plant consists of four 300 H. P. Hazelton or "Porcupine" boilers, each being connected to a bagasse furnace common for all four boilers and which is fed through a single hopper. The furnace has shaking grates and is supplied with air through an automatic safety air grate by a "Buffalo" blower driven by independent engine. The entire boiler plant, including independent engines for blower and trash carriers, is intended to be operated by one man, who, it is claimed, can give all the attention required.

Remarks.—The green bagasse furnace is entirely different from any other arrangement in this country. It has, I understand, been very successful in Cuba. The bagasse is fed through a hopper on top of main combustion chamber to furnace and the bagasse is burned in a pile under forced draft. In operation, the fire and ash doors are sealed, the air passing under grate and sides through the above-mentioned safety air gate, which, if blower is stopped, automatically opens to admit cool air, thus preventing the burning out of grates. Each boiler is fitted with independent grates, combustion chambers, stack and damper, so that each can be operated independently.

EVAPORATORS.—There are two standard triple-effect evaporators, mounted on cast iron columns and wrought iron frame work, each fitted with a Blake crank and flywheel double pump (for wet system), spray bowl condenser, separators, the necessary juice, sweet water pumps and traps, each apparatus guaranteed to reduce 5,500 U. S. gallons juice per hour from 10° to 30° Beaume.

Remarks:—These evaporators are of the vertical type with tubes not submerged. Tubes are not completely filled and each tube is expected to do its equal share of work as the juice cannot leave it until reaching the proper temperature, when it vaporizes and is ejected. In the center of each effect, is a central passage about 16 inches in diameter, with an open float secured by collars on a vertical rod. This rod is connected by a lever to a wrist pin and thereby to a lever outside, which in turn is connected to the arm of a butterfly valve placed in the juice pipe to the next effect, and carries a counter-balance weight. This device controls the admission of juice to the effects. The juice entering the first effect fills the tubes about three-quarters of their length, then it is blown out and falls on the upper tube sheet (a raised flange at top of central passage holds the juice on upper tube sheet at a suitable depth). From the upper tube sheet, the juice overflows into the central space, filling it up about two-thirds until the float opens the butterfly valve to next effect in the tubes of which the juice rises to about three-quarters height where it is maintained when working at approximately its normal capacity. This is repeated for the first and second effects, the juice from the central chamber of the last effect being drawn off as fast as it overflows. The tubes of each effect project above the level of the raised flange so that there may be no back flow into them.

The smooth working of the apparatus is secured by feed box placed between the juice and syrup tail pumps on the vacuum engine which is automatic in operation and will feed a constant quantity of juice without attention. With this apparatus, the makers claim that there is no excuse for overflowing or interruption of service and only requires uniformity of steam pressure and sufficiency of juice supply.

VACUUM PANS.—These are two in number, 12 ft. inside dia., each pan being fitted with fourteen-four inch copper coils, with drains and traps, and guaranteed to produce 44,000 lbs. of sugar in five hours; connections for live and exhaust steam; large vapor pipes with separators and spray bowl condensers, etc.

CLARIFIERS.—These consist of circular tanks with slightly dished bottoms, fitted with one continuous copper coil to heat all juice to or near boiling point.

FILTER PRESSES.—The filter presses are of the ordinary type, twelve in number, having 6,000 sq. ft. total filtering surface.

CENTRIFUGALS.—These are water-driven machines of American manufacture, sixteen in number, forty inch dia., fitted with corrugated brass slat conveyor and bucket elevator.

CRYSTALLIZERS.—The crystallizers are of the Bock system, four in number, for low grade sugars only, each having 750 cubic feet capacity.

LIMING OF THE JUICES.—The juice is mixed to a proper density in a mixer and pumped to the first and second mills, where it is applied as milk of lime on the bagasse. The supply to each mill is under the control of the chemist, without affecting the work of the man mixing the milk of lime, who simply keeps the tank or mixer full at the proper density. The juice is supposed to leave the mills alkaline and is pumped through the sulphurizer cold, for neutralization. From the receiver of this, it is automatically pumped through the heater up to the clarifiers, where it is allowed to stand at a constant temperature. The makers anticipate that this clarifying system will do good work on account of the high purity of Hawaiian cane juices, and their freedom from certain impurities found in Cuban cane, which it has long worked successfully.

(Signed) WM. STODART.

P. S. This complete plant was designed and furnished by Mr. O. B. Stillman, New York, and erected by Messrs. Catton, Neill & Co. Ltd., Honolulu. The buildings are all of structural steel material with corrugated galvanized iron on sides and wood covering on steel roof trusses. The Buildings were manufactured by Messrs. Milliken Bros., New York, to the design of Mr. Stillman.

GENERAL DESCRIPTION OF NEW SUGAR FACTORIES ERECTED DURING 1901.

THE "PUUNENE" MILL FOR THE HAWAIIAN COMMERCIAL & SUGAR CO.

Maximum Capacity: About 3,600 tons cane in 24 hours.

BUILDINGS.—The buildings are all constructed of steel structural material with sides and roofs covered with galvanized corrugated iron. The ground floors are all made of cement concrete, the upper floors of T. G. wood on steel joists. The centrifugal floor is made of cement concrete on arched corrugated iron and the bagasse firing floor is of checked steel plates bolted to "I" steel beams. The whole factory may be considered as practically fire-proof.

The various buildings are all jointed together and cover about 108,000 sq. ft. of ground surface, or nearly 2½ acres. The general dimensions are as follows:

Three mill buildings 114x183 ft. and 30 ft. to roof trusses.

Three cane carrier sheds, each 36x120 ft. and 20 ft. to roof trusses.

Boiler and bagasse room, 133x183 ft. and 30 ft. to roof trusses.

Clarification and evaporation building, in three floors, 75x209 ft. and 70 ft. to roof trusses.

Centrifugal, crystallizer and vacuum pan building, in four floors, 75x209 ft. and 70 ft. to roof trusses.

Filter press building in two floors, 55x123 ft. and 28 ft. to roof trusses.

Sugar bagging room, 30x208 ft. and 36 ft. to roof trusses.

Railroad shipping shed, 21x208 ft. and 20 ft. to roof trusses.

Look-out tower, 18x18 ft. and 110 ft. from the ground.

The factory is situated at a sufficient elevation to allow the cooling water, after being used in the condensers, to irrigate the lower cane lands; this water will amount to from six to twelve million American gallons for every twenty-four hours, and will carry away with it all waste products and refuse from the factory.

MACHINERY.

CANE MILLS.—There will be installed three sets of crushing plants, each consisting of a nine-roller mill with rollers 34x78 inches, and built in connection with each plant is a Krajewski-Pesant Cane Crusher with rollers 26x72 inches, driven, in one of the plants, by a separate gearing and engine, and in the other plant by the 30x60-inch Corliss mill engine through a train of gears from the main gearing. Which of these plans will be followed in the third plant, is at present undecided. The gearing for each set of mills is constructed as one train of gearing wheels, fitted with steel rims and steel pinions, and the engine driving each set of mills and crusher is of the Corliss type, 30 inch dia. of cylinder and 60 inch stroke.

These mills are fitted with hydraulic mill pressure regulators, having 11 inch rams, and each mill has an independent accumulator and force pump. The pressure applied will vary from 370 to 385 tons on the first mill and from 410 to 425 tons on the last set of rollers. There is also an automatic juice strainer fitted to each mill, conducting the strained juice to one independent juice pump for each mill. A 15 tons lift steel traveling crane, with two trollies, is erected over each set of mills, and travels the entire length of the mill building, reaching all of the machinery therein.

Each cane carrier is fitted with an automatic cane unloader, raking the cane from the cane cars on to the cane carrier from both sides, and all the loaded cane cars pass over a scale before entering the cane shed, as also do the empty cars leaving. The system of tracks in the yard is most perfect and there will be storage room for about 2,000 tons cane on parallel tracks, laid with a slight inclination towards the cane sheds.

Boilers.—In the boiler room are installed two batteries of ten boilers each, facing a bagasse floor between them 60 ft. wide and 133 ft. long, adjoining to, and at same level as, the mill floors. The type of boiler is the common multitubular, 7 ft. in diameter and 20 ft. long, each boiler having about 2,900 sq. ft. heating surface. The grate is of the stepped type with short horizontal foot grates, and the ratio of grate to heating surface is about 1-60. There is no forced draught to the furnaces. The furnaces are built out from the fronts sufficient to allow the flame of clear combustion to reach the whole bottom and sides of boilers, returning through the 4-inch tubes to an uptake bolted to the front and provided with a damper. These uptakes bolt with their upper ends to the bottom of a common iron flue, located over the ends of the boilers, and conducting the gases of combustion from each battery of ten boilers to the smoke-stacks. There are two smoke-stacks, one for each battery of boilers, made of steel plates and lined with bricks. They are 12 ft. 6 in. in diameter and 180 ft. high from the grate surface. They are "self-supporting," having no guy ropes. Room has been left between the last boiler and the stack for the installation of a fuel economizer if found necessary later on. The arrangement is such that any one boiler can at once be cut out without interrupting the work of the other boilers, and the 4-inch boiler tubes are readily cleaned from the rear end as well as from the front. The bagasse is elevated from each of the three sets of mills to a horizontal conveyor located at the mill end of the boiler room. From this, it is delivered automatically to two horizontal conveyors, one located over each row of furnaces. The system of bagasse conveyors is arranged in such a manner that the bagasse from each one of the milling plants may be divided between each of the two batteries of boilers, or all the bagasse may be sent to one battery only, either from one of the mills or from all of them, as may be required. The whole system is driven by two small engines.

In the conveyors over the furnace, are trap doors, adjustable from the floor, from which the bagasse drops on to a movable chute for each boiler, sending it either into the automatic furnace feeders, or, if not required immediately, on to the bagasse floor. Later on, an elevator will be installed, by which this surplus bagasse may be automatically conveyed back to the upper horizontal carrier and pass over the furnaces a second time along with the fresh bagasse from the mills (or when the mills are temporarily stopped) saving all handling by men.

Each furnace is provided with an automatic furnace feeder in which a trap door is adjusted to open and close at regular intervals, thereby regulating the proper amount of feed. There is also a common fire door, level with the bagasse floor, in order to allow of hand firing in case any accident to the bagasse conveyors should temporarily stop the automatic firing. It is supposed that two men will readily attend to the firing of the ten boilers in each battery.

Clarification.—The mixed and diluted mill juice will be pumped by the three direct-acting duplex mill juice pumps (one for each mill) up to any one of three small receiving tanks, located at the highest point in the clarification building, one over each of three automatic juice weighing machines. The weight of the juice passing through these machines is automatically recorded and samples of this juice automatically thrown out at the rate of about six samples per minute. From the weighing machines, the juice runs down into any one of four liming tanks, of such a capacity as will allow the juice to stand about twenty minutes after being treated with milk of lime. An air compressor forces air into a perforated pipe located at the bottom of each tank, keeping the juice in constant agitation. The necessary tanks for slacking, mixing and straining the lime are located in a closed room over the liming tanks, allowing the milk of lime to run in measured quantities into any one of the liming tanks; and the lime barrels are elevated from the ground outside to this floor by a hydraulic elevator.

The limed juice enters one of two pump tanks, from where it is drawn by gravitation down into the suction end of either one of three pumps, of the duplex direct-acting type, located on the floor below. On same floor as the liming tanks, are located three complete "Deming" superheating clarification apparatuses (known as No. 7), each consisting of one pipe "Absorber" and two "Digestors." The limed juice is forced by above-mentioned pumps, one for each apparatus, through the Absorbers and Digestors in the usual manner with a velocity of about 70 inches per second, in order to keep the tubes clean, and after having been subjected to a suitable heat, about 230°-260° and again cooled to about 200°, it enters the Deming continuous settlers. There are three sets of these, one for each apparatus, and each set consists of three large tanks with conical bottoms, and inside cones, allowing the juice a very slow motion in a continuous flow. These settlers are arranged in such a manner that they may be worked singly or in series. The general arrangement of the Deming clarification system is such that either one, two, or all three apparatuses may be worked according to the amount of juice to be treated.

FILTRATION OF JUICE.—On the floor below the Deming apparatus is installed a battery of mechanical sand filters, in two rows, with 10 filters in each. These filters are vertical cylinders, each of about 20 cubic feet capacity sand. They are constructed with a center tube made of fine perforated brass wire screen, and a number of rings placed near the shell prevents the sand from packing against the sides. The partly settled juice enters at the bottom from a supply tank located about 12 ft. above, and, filling the spaces between the rings, gradually forces its way through the sand to the inner pipe, into which it drains from all sides until the sand becomes saturated with dirt and will not allow more juice to pass through. The juice runs from the filters almost sparkling clear and is conducted through a pipe to four supply tanks located about 20 ft. above the floor of the evaporators. The dirty sand is first washed out until the water shows no saccharine. The bottom gate is then opened and the water washes the sand down into a washing machine, constructed as an inclined revolving drum, from the lower end of which it is elevated automatically to a bin above the filters from where dumping cars suspended from trollies running on tracks over the filters, deliver the clean sand to where it is wanted for refilling the cells. This whole operation is supposed to be handled by three unskilled men.

EVAPORATORS.—There are two evaporators, each of a capacity to reduce in 24 hours, 500,000 American gallons of juice at 15° Brix. to 54° Brix., using only exhaust steam at 5 lbs. pressure to the first cells. These evaporators are of the "Lillie" automatic film evaporator type and both are quadruple effects, but arranged so that they can be worked with five, six, seven and even eight cells, with exhaust steam only to one first cell, if found advantageous. Each quadruple-effect has a condenser and duplex, crank and flywheel vacuum pump, working on the "dry" system; the bottoms of condensers are about 34 ft. over the water in the sealing tanks. To each apparatus is fitted an automatic density regulator, insuring the constant density of the syrup when leaving the apparatus. The syrup is pumped by a direct-acting duplex pump from each apparatus up to the main pipe located over the vacuum pan supply tanks.

VACUUM PANS.—These are located on the same floor level as the Deming apparatus. There will be installed six pans, each with a capacity to strike thirty tons sugar three times in 24 hours. Each one is provided with fourteen coils, 2½ inches in diameter, and arranged to admit live steam of 40 lbs. pressure, or exhaust steam. The discharge sugar gates are 30-inch diameter and the arrangement of the soils allows 6 inches clear space between them. The condensers are very large and each pan has an independent water leg, same as the evaporators, making the vacuum pan work on the dry system. There is an independent vacuum pump of the single direct-acting type, for each pan, directly under the control of the sugar boiler, on the vacuum pan floor. All the vacuum pans are connected at the bottom with a 6-inch pipe and a valve at each pan. This will allow part of a strike to be transferred to any one of the other pans, by a suitable adjustment of the vacuum.

CRYSTALLIZERS.—At present only 12 crystallizers will be used for but low grade sugars. Floor space is, however, provided for a maximum installation of thirty similar crystallizers. The construction of the crystallizers is the closed, jacketted type, with internal spiral stirrer, revolving about 1½ times per minute. The capacity of each crystallizer is about 1,500 cubic feet or 20% more than the capacity of one vacuum pan, so that one strike hardly fills one crystallizer. The masse-cuite enters any one crystallizer through a system of large pipes and is discharged into the mixers over the centrifugals by means of compressed air being admitted over the masse-cuite in the closed crystallizer. One compound slide valve engine drives the countershafts from which all the stirrers are driven, and it is of sufficient power to drive all future installations. These crystallizers are installed with a complete system of piping for steam, water, molasses and air, and they are built perfectly circular inside with flush rivetting, allowing the spiral scraper to almost touch the inner shell, thereby preventing the formation of cakes and sugar scales.

CENTRIFUGALS.—There will be installed three batteries of eight centrifugals, and each battery will be supplied from a mixer of sufficient size to hold one full strike of masse-cuite from any one of the vacuum pans. These three mixers are separated by a partition with a gate, whereby it will be possible to purge three different grades of sugar at one time, or, if required, one grade together in all of the mixers. The whole installation will therefore consist of twenty-four centrifugals, each 40 inches in diameter and 24 inches deep, driven by Pelton water motors with two nozzles attached to the top of the spindles. Each set of eight machines will be worked by a separate pressure pump fitted with cylinders, 22-inch steam, 12-inch water and 24-inch stroke, of the duplex direct-acting type. Each pump draws the water supply from a tank and after the water has passed through the motors, it is returned to this supply tank, to be used over and over. The working pressure of the water will be from 160 to 180 pounds per square inch, and each centrifugal will dry about 3,000 pounds sugar per hour. The molasses will run out into four large tanks, each provided with a system of perforated pipes through which steam or water may be blown into the molasses. Two separately connected plunger pumps draw the diluted molasses from these tanks and force it up into any one of the vacuum supply tanks, located on the vacuum pan floor, from where it may be drawn into any one of the vacuum pans or crystallizers.

SUGAR-MIXER AND COOLER.—The sugar discharged from the centrifugals drops down on to a horizontal screw conveyor, which discharges it at one end into the boot of a bucket sugar elevator conveying it up to a suitable height. From this elevator it falls on a fast revolving fan which throws it out against a screen, breaking up all lumps and thoroughly mixing and cooling the sugar before it collects in a large bagging bin built with slanting bottom towards four openings where the bagging and weighing machines are located. All the iron work coming in contact with the sugar is galvanized, and the bagging bin is lined with galvanized iron sheets. At present only one sugar mixer and cooler will be installed in connection with one set of eight centrifugals.

The Sugar Storage Room under the centrifugals and bagging bins is of sufficient capacity to store about 20,000 bags sugar, or about 1,200 tons, the ultimate daily output being about 8,000 to 9,000 bags per day of 24 hours. The locomotive can pass into the sugar room, the bottom of cars being level with the floor, and 200 feet of cars may be loaded at one time, protected by the roof.

FILTER PRESSES.—These are located in a separate building, built together with the clarification house. The supply tanks for the settlings are situated below the bottom of settling tanks and all mud and washing waters containing sugar run down by gravitation. Two pumps of the duplex, plunger type, draw the diluted and limed mud from these tanks and force it through two main supply pipe lines to two rows of filter presses. There is floor space for an ultimate installation of twenty-four filter presses of 1,000 square feet capacity each, and eight such presses are installed for the first season. They are of double-ended construction, having the inlets in the center and are fitted with "wash out" attachment.

The partly solid mud cakes drop from the bottom of the presses, through the floor, down into two screw conveyors, one for each row of presses, and the cakes are discharged at the ends, outside of the building, into suitable railroad dump cars, removing this material to the fields as fertilizer. The dirty filter press cloths are sent through a chute down to the ground floor, where they are cleaned in two revolving, metal washing machines. When clean, they are elevated by a hydraulic elevator up to the filter press floor.

Water Supply.—The water supply required for this factory will be from 6 to 12 million American gallons continuous flow in 24 hours, according to the daily output. It is not proposed to use the water over again after being cooled. The supply will be taken from an irrigation ditch located at a distance of 2,000 feet from the factory and 15 feet above the mill ground floor. There is a large cemented hot water sealing tank into which is conducted all the condensing water from the condensers of the vacuum pans and evaporators. As the sealing tank could not be lowered to any extent on account of drainage, it became necessary to have the bottom of the condensers 34 feet above the water in this tank so as to insure the safe barometric column, working the vacuum pumps dry. This waste condensing water, together with all drainage from the factory, will accordingly empty itself outside into a main drain, from where it is conducted to the irrigation furrows in the cane fields located below the factory. At times, however, irrigation is more needed on the higher situated fields. There is therefore installed, just over the sealing tank, a large centrifugal pump, driven by a direct-coupled compound engine, which pumps this water through a separate pipe up into an irrigation ditch, located somewhat lower than the supply ditch, and at some less distance from the factory. It will therefore be seen that all the water used in the factory will be used afterwards for irrigation purposes.

Piping.—It may have been noticed in following the above description, that all the machinery installations have been arranged, as well as practicable, in three units, each with a capacity of about 1,200 tons cane, or 150 to 170 tons sugar, in 24 hours' continuous run. The pipe systems have therefore been arranged with the main principle in view, that either one of the units may be operated independently of the two others, or all may be worked together as a whole. For the coming season starting January, 1902, only two units will be installed and operated, the third will be added later when required. The main steam pipes from the boilers will start with 110 lbs. pressure and reach all engines, Deming apparatus and vacuum pan coils. The exhaust steam from all engines will be conducted to evaporators, Deming apparatus and vacuum pans. The water from the condensed live steam will be pumped direct to the boilers and from the exhaust steam to a hot well, which is a tank divided in several compartments, through which the water slowly passes, separating the oil it contains before entering the boilers through the feed pumps.

FUEL.—While it is expected that with the use of maceration water to an extent of about 15% to 20% of the normal juice, the amount of bagasse from the mills will be ample to generate steam for operating the entire factory during steady, uninterrupted grinding, including the pumping of the used condensing water back to the irrigation ditch,—the two boilers in each battery have been fitted with furnaces which at short notice can be transformed into coal burning furnaces, with horizontal grate bars, if this should be found necessary.

ELECTRIC PLANT.—The lighting system consists of fifty incandescent lamps of 64 candle-power each, fitted with reflectors and arranged outside on poles in the track yard. There are also 400 16 candle-power lamps distributed throughout the buildings. The engine is of the high-speed, self-contained type, directly coupled to the dynamo, which is of the constant potential type. The switch-board, main conductors and general wiring is of the most improved style, as is the whole of the plant.

MACHINE SHOP.—The machine shop, blacksmith and carpenter shops, will all be located in separate buildings, and the machine shop is supplied with a steam plant and a number of lathes, planers, shapers, drill presses, bolt and pipe cutting machines, etc., in fact it will be so well equipped that almost any repairs may be made, outside of handling mill rollers and making castings.

This large sugar factory was planned and designed by the Honolulu Iron Works Co., acting as consulting engineers to the Hawaiian Commercial & Sugar Co., and the work of erecting the whole factory is now almost completed under their supervision. The first consultations were held in April, 1900, between Mr. H. P. Baldwin and Mr. J. B. Castle, representing the owners, Mr. W. J. Lowrie, the general manager, and Mr. C. Hedemann, manager of Honolulu Iron Works Co. The active work on the foundations commenced in August, 1900, and on the buildings and machinery in January, 1901, under the superintendence of Mr. J. N. S. Williams, who had previously superintended the drawing work for the Honolulu Iron Works Co., and it is reasonably expected that the completed factory will start work grinding cane in January, 1902.

The buildings, smoke-stacks and traveling cranes have been designed, manufactured and erected by Messrs. Milliken Bros., New York. The first milling plant was built by the Fulton Iron Works Co., St. Louis. The second milling plant was built by the Honolulu Iron Works Co., the two first cane crushers by Messrs. Krajewshi-Pesant Co., New York. The boiler plant was built complete by the Honolulu Iron Works Co.; the Deming clarification apparatus was furnished by Mr. E. W. Deming, New Orleans; the automatic juice weighing machines were built by the Honolulu Iron Works Co., also the sand filters. The Lillie Evaporators were furnished by the Sugar Apparatus Manufacturing Co., Philadelphia; the vacuum pans and crystallizers by the Kilby Manufacturing Co., Cleveland; the centrifugals by the American Tool & Machine Co., Boston; the first installation of filter presses by the Stilwell-Bierce and Smith-Vaile Co., Dayton; almost all the tanks, piping and fittings by the Honolulu Iron Works Co.; the pumps for general boiling house use, by the Geo. F. Blake Manufacturing Co., New York; the vacuum pans for the evaporators and the pressure pumps for centrifugals by Guild & Garrison, Brooklyn; the vacuum pumps for vacuum pans by the Geo. F. Blake Manufacturing Co., New York. All the conveyors and elevators for bagasse and sugar by the Link-Belt Machinery Co., Chicago.

C. Hedemann.

Honolulu, Nov. 4, 1901.

OLAA MILL—ERECTED FOR THE OLAA SUGAR CO.

Capacity.—This factory is designed to grind the first and second years, 1,200 to 1,300 tons cane per day of 24 hours' continuous work, with a daily output of about 160 to 180 tons sugar. The buildings are, however, constructed with sufficient floor space and general dimensions to allow additional machinery to be installed as soon as required, which will double the above-mentioned daily capacity.

Buildings.—These consist of a mill and a boiler room in one building, a clarification building, a building for vacuum pans, evaporators, crystallizers and centrifugals, a sugar-bagging building and a railroad shed. These buildings are all jointed together, forming one factory, covering 51,550 square feet ground surface, or about 1 2-10 acres. The general dimensions are:

Mill Room, 100x70 ft.—26 ft. to roof trusses.
Boiler Room, 87x70 ft.—26 ft. to roof trusses.
Clarification House, 126x91 ft.—36 ft. to roof trusses.
Vacuum Pan House, 140x91 ft.—70 ft. to roof trusses.
Sugar Room, 140x40 ft.—34 ft. to roof trusses.
Railroad Shed, 140x20 ft.—17 ft. to roof trusses.
Cane Carrier Shed, 149x39 ft.—20 ft. to roof trusses.

Look-out Tower, 12x10 ft.—100 ft. from ground.

All the buildings are constructed of steel structural material covered on sides and roofs with corrugated galvanized iron. The ground floors are made of cement concrete; the bagasse floor of checked steel plates, bolted on steel "I" beams; the filter press and centrifugal floors of cement on arched corrugated iron; the crystallizer, vacuum pan and engine room floors of T. G. wood on steel joists. All staircases, railings, doors and ventilators on top of roofs are made of iron. The buildings may be considered practically fire-proof. The factory is situated so that cane may be brought to the mill either by flume or by railroad, and the trains of the Hilo R. R. Co. may pass through the shipping shed, allowing 140 feet of cars to be loaded at one time under roof, with bottom of cars level with sugar bagging floor.

MACHINERY—FOR PRESENT CAPACITY.

CANE MILL.—There is installed one crushing plant, consisting of a nine-roller mill with rollers 34x78 inches, and all three rollers are coupled to one gearing common for all the mills, with the gearing wheels made with steel rims and all pinions and mill crown wheels made of steel. One Corliss engine, 28x60 inches, drives all the rollers. To the first mill is built a Krajewski Cane Crusher, with rollers 26x72 inches, and coupled to a separate compound gearing with a Corliss engine, 18x42 inches, to drive the crusher. The mill is fitted with hydraulic pressure regulators having 11-inch rams, and each three-roller mill has an independent accumulator and force pump. The pressure will be from 370 to 385 tons on the first set of rollers and from 410 to 425 tons on the last set. There will be fitted to these mills an automatic juice strainer, conducting the strained and mixed juice to a tank under the floor, from where a duplex direct-acting pump forces it up to the highest point in the clarification house. A 15-tons steel traveling crane, with two trollies, operated from the floor, travels over all the milling machinery, the whole length of the mill room.

The cane carrier is fitted with an automatic cane car unloader, operating from both sides of the carrier, and when the cane is not transported by railroad but by water flume, it will slide from the lower end of the flume on to the carrier at the end, and the water will escape through an iron grate before it reaches the carrier and be conducted through a series of screens to the supply cistern located near by the water supply pump, to be described later.

BOILERS.—There is installed one battery of seven multitubular boilers, 7 feet in diameter and 20 feet long, each having a heating surface of 2,900 square feet. The seven furnaces are each 5 ft. 9 inches wide and the grate is of the ordinary stepped pattern with a short set of horizontal bars at the bottom. The ratio of grate surface to heating surface is about 1-60. There is no artificial draught. The furnaces are built out from the boiler fronts sufficiently to allow a clear frame on the whole bottom and sides, returning through the 4-inch tubes to the front end, where an uptake of iron, bolted to the boiler front, conducts the gases of combustion to an iron flue common for all the boilers, and leading to the smoke stack. Each uptake is fitted with a damper, allowing any one, or more, boilers to be cut out without interrupting the work of the other boilers. Room is left open between the last boiler and the smoke-stack for a fuel economizer if such an installation should be needed later. In the wall of the building, at the rear of the boiler setting, is arranged an iron roller shutter opposite each boiler, allowing the tubes to be readily cleaned, also from the front through the door in the iron uptake. There is one smoke-stack, 10 feet in diameter and 180 feet high from the grate. It is made of steel, lined with bricks, and is self-supporting, having no stay guys.

The bagasse is elevated from the last set of rollers and delivered on a horizontal carrier located over the front of the furnaces. Over each furnace is a trap door in this carrier, adjusted from the floor, and the bagasse falls in the desired quantity from these trap doors on a movable chute, either into the automatic furnace feeders, or, if not required, on the bagasse floor in front of the boilers. This floor is level with the top of the stepped grate and a furnace door is provided, through which hand firing may be resorted to when the mills stop temporarily. The automatic furnace feeders are constructed as iron hoppers, each provided with an automatic working trap door, adjusted to open and close with regular intervals, or left open a certain amount all the time, if so desired. An independent engine drives all the bagasse conveyors.

Clarification.—The mixed and diluted mill juice is pumped up to a small receiving tank located over the automatic juice weighing machine. This machine records the weight of the juice passing through it and throws out samples for analysis at regular intervals. The juice then enters one of three liming tanks (circular), each of 5,700 gallons capacity. Through a supply pipe, milk of lime, at a known density, is measured out to the juice, and from a perforated pipe at the bottom of each tank, compressed air is keeping the juice in constant agitation. One tank is therefore being limed, while one is being emptied, and one is standing "tempering." The milk of lime is pumped in a constant current through the pipes from the slacking and mixing tanks, located on the lower floor over the liming tanks, and driven to the tanks again, preventing it settling in the pipes.

The limed juice enters the pump tank, from where it is drawn down to the circulation pump for the Deming clarification apparatus. This pump is of the duplex, direct-acting pattern, and forces the juice up through the absorber and digestors of the Deming apparatus. This is known as the "No. 7 Deming" and the juice is forced through the tubes with a velocity of about 70 inches per second, thereby preventing the settling of dirt, and after being heated in the digestors to about 230°-260° and again cooled in the absorber to 200°, it is discharged into the outer compartment of one Deming continuous settler. After passing to the inner compartment, the partly settled juice enters, through a main supply pipe, any one of sixteen open settling tanks, each 7 feet in diameter and of 1,200 gallons capacity. The juice may also enter these tanks direct from the Deming absorber, passing the continuous settler, if this should be found advantageous, for instance, when "boiling off." After the juice has settled, the clear juice under the "blanket" is drawn off through a copper pipe attached to an adjustable copper float in each settler, and runs by gravitation into the 4,000-gallon supply tank for the evaporator, located under the settling floor and 15 feet 8 inches over the evaporator floor.

At present, no mechanical filters will be installed. If they should be required, room is provided for such an installation directly under the settling tanks. The whole process of liming, clarifying and settling the juice takes place on one floor, directly connected with the vacuum pan floor by a bridge and a few steps.

Evaporators.—There is installed one quadruple-effect of the Lillie automatic film evaporator type, of 350,000 American gallons capacity in 24 hours, from 15° Brix. to 54° Brix. using only exhaust steam of 5 lbs. pressure to the first cell. This apparatus is provided with a large oil separator in the steam pipe, and also with an automatic density regulator, allowing the syrup to escape only at a constant fixed density. The condenser is elevated sufficient to allow the necessary barometric water column to insure the vacuum pump working "dry." The vacuum pump is of the duplex crank and fly-wheel type. The syrup is pumped by a duplex direct-acting pump to a main supply pipe located over the supply tank for the vacuum pans on vacuum pan floor.

Vacuum Pans.—These are located at such an elevation that the masse-cuite will enter the crystallizers, and from them the mixer over the centrifugals by gravitation, and the sugar will drop from the centrifugals into the bags on bagging floor. From the vacuum pan floor, is an uninterrupted view over the entire clarification building, and evaporator to the one side, and centrifugals and sugar bagging room to the other side. There are at present installed three vacuum pans, with space left for two more. All the pans are constructed exactly alike, each being fitted with twelve 2½-inch coils, giving about 1,000 square feet heating surface. Each pan will strike about 25 tons dry sugar three times in 24 hours, if required. The coils may either be supplied with direct steam, reduced to 40 lbs. pressure, or exhaust steam of 5 lbs. pressure. The discharge gate is 30 inches in diameter. The condensers are very large and located at such an elevation as will insure the sufficient barometric water column from the bottom to the sealing tanks on lower floor. The vacuum pumps are of the direct-acting type and each pan is provided with an independent vacuum pump located on the vacuum pan floor, under the direct control of the sugar boiler. These pumps all work "dry." The drain from coils using direct steam is piped down to the lower floor where the hot water enters a closed recipient, from the top of which the steam is conducted to the main exhaust pipe line, and the hot water is pumped from the bottom directly into the main feed pipe to the boilers. The drain from coils using exhaust steam is conducted directly down to the "hot well" from where the feed pumps draw the supply to the boilers. The vertical distance from drain manifold on vacuum pans to hot well is 40 feet and this "fall" will insure the perfect drainage of the coils.

Crystallizers.—There is installed, for the present mill capacity, fourteen crystallizers (in two rows), each of sufficient capacity to hold one full strike of masse-cuite from any one of the vacuum pans, and with additional room for adding molasses, syrup, water, etc. Floor space is, however, left open for the installation of in all twenty-four such crystallizers if later required. Through a system of large pipes, the low-grade masse-cuite is discharged from any one of the vacuum pans into any one of the crystallizers, and after being treated, it is again discharged from the bottom through pipes to either one of the two compartments in the mixer over the centrifugals. Compressed air, being pumped into the closed crystallizers, will assist a speedy discharge. One 14x36-inch Corliss engine, located on the ground floor, drives the two countershafts from which the stirrer apparatus in each crystallizer is operated by a worm and worm wheel. The internal spiral scraper almost touches the perfectly cylindrical and flush riveted shell. A complete and elaborate system of piping is fitted to each battery of crystallizers, admitting water, molasses, syrup, air and steam, both to the interior and the surrounding jacket.

Centrifugals.—This installation consists of a battery of twelve 40x24-inch centrifugals, belt-driven. An 18x42-inch Rollins engine situated on the ground floor, drives all these machines, with sufficient power also to drive a future installation of twelve more centrifugals, if required later.

The mixer is divided into two separate compartments, with a gate in the partition, each compartment being of sufficient capacity to hold one full strike of masse-cuite from any one of the vacuum pans. This arrangement allows either one grade of sugar to be dried in all the centrifugals at one time, or two grades, divided over seven centrifugals for first grade sugar and five for second grade. The molasses runs out through two iron troughs into any one of four molasses tanks of 2,500 gallons capacity each. These tanks are each fitted with perforated piping, admitting steam, water or milk of lime to the molasses. One pump of the duplex direct-acting plunger type, draws the molasses from any one of these tanks and forces it up into any one of the supply tanks located on the vacuum pan floor.

SUPPLY TANKS.—The supply tanks for the vacuum pans are at present of 43,100 gallons capacity, divided in twelve compartments in a tank 96 feet long. Room is left open for a future addition to this system of tanks. Over these tanks are located supply pipes for syrup from the evaporators and molasses from the "blow-up" tanks. There are also pipe lines for water and milk of lime. The bottoms of these tanks are three feet above the vacuum pan floor, allowing the system of discharge piping to be within easy reach and allowing the vacuum pans to be partly filled without vacuum.

BAGGING.—The sugar drops from the bottom of the centrifugals directly down into the sugar bags from an iron hopper receiving sugar from two centrifugals. The bags stand on small trucks and are wheeled away to the sugar room for temporary storage.

FILTER PRESSES.—In the clarification house is all the machinery pertaining to the liming, clarification and settling of the juice located on a gallery floor running the entire length of the building on the right-hand side from the mill building. On the left-hand side is located a similar gallery floor at the same level as the clarification floor and connected with it by a gallery at the mill end of the building. On this floor, is located at present, ten filter presses with 500 square feet filtering surface each, but room is left open for the installation later of four more. These presses are fitted with washing out attachment and are all connected to main supply pipes for mud, water and steam. The elevation of these presses is such that the clear juice runs by gravitation from the troughs into the supply tank for the evaporator. The settlings from bottom of all the settling tanks run down into one of the mud tanks located under the settling tank floor, and a duplex direct-acting plunger pump, located on the ground floor, forces it up through the main supply pipe to the presses. Under each press is an opening in the floor through which the mud cakes drop on declining chutes reaching through the wall of the building over any one of two iron dumping cars running on a track just below the end of the chutes outside. The dirty filter press cloths are dumped through a chute in the floor down to the ground floor, where they are cleaned in a revolving metal washing machine, located in a shallow iron tank. When cleaned, they are elevated to the filter press floor and replaced in presses.

Tanks.—On the ground floor, under the supply tank for the evaporator, are placed four tanks, each with a capacity of 4,000 gallons. These tanks are to contain either alkaline water for cleaning the steam side of the evaporator, or low grade molasses in case there should be at any time an unexpected necessity for additional storage capacity. A direct-acting pump is located under these tanks for the delivery of the material either to the evaporator or to any one of the vacuum pans.

Water Supply.—A flume, about 15 miles in length, conducts water through the cane fields from various sources, located at a considerable elevation above the plantation, down to the mill, ending at the head of the cane carrier. Where convenient, cane is flumed down in the flume to the mill, and the water is conducted through several screens to a reservoir located close to the mill building. On the ground floor, in the vacuum pan house, is located a duplex direct-acting compound pumping engine with a capacity of delivering six million gallons water in 24 hours to an elevation of 100 feet. This pump draws the water from the reservoir and forces it into a stand pipe, 4 feet diameter, located close to the pump and outside the building. The upper, open end of this stand pipe is higher than the roof trusses in the vacuum pan building and from the lower end extends a manifold branch pipe, to which is connected pipes leading the injection water up into all the condensers for vacuum pans and evaporator, and for general use throughout the factory. A 12-inch overflow pipe leading from the top of the stand pipe back to the reservoir prevents overflow. An automatic float arrangement acting on the steam valve of the pump will serve to regulate the speed of the pump to suit the demand for water and a gauge will at any time show the attendant of the pump the height of the water in the stand pipe. It is, however, decided to build a large reservoir on the higher lands, run part of the flume water into it, and draw the mill supply from there, thereby saving pumping.

Drains.—There is a perfect system of drainage throughout the entire factory, and all the discharge water from the condensers and flume water not actually needed, rushes through the cemented drains and carries all refuse and waste along with it. As Olaa plantation depends entirely on rainfall, there is no artificial irrigation, and all this water runs therefore to waste.

Piping.—All main, direct and exhaust steam pipes, also all main pipes for juice, water, molasses and settlings, are made large enough to accommodate additional machinery installations in view of later doubling the capacity of the factory. No cast iron pipes have been used, only seamless wrought iron pipes of various thicknesses to suit the pressures. All flanges have been expanded to the pipes and "beaded" over, and expansion has been carefully provided for. All pipes conducting steam are covered with asbestos from 1½ to 2½ inches thick according to temperature of steam. All engines are provided with valves in the exhaust pipes and every precaution has been taken to prevent an accident to any of the smaller engines or pumps causing a stoppage of the entire factory.

ELECTRIC LIGHT PLANT.—In the engine room is installed a Westinghouse generator, driven by an "Atlas" automatic engine. There will be installed eight arc lights in the cane carrier shed, mill, engine and boiler room, and four hundred 16 candle-power incandescent lights distributed all over the entire factory. This electric plant will be of the most modern and improved type.

MACHINE SHOP.—Adjoining the mill room is built a machine shop entirely of steel structural material. In this is installed several lathes, a planer, a shaping machine, a drill press, bolt and pipe cutting machinery, smith's forge, and in fact everything which will be required to make almost any repairs of an ordinary character.

This sugar factory was designed and planned by the Honolulu Iron Works Co. and will be furnished by them complete in every respect, erected and started in satisfactory working order under a contract with the Olaa Sugar Co. This contract was made in October, 1899, the buildings were ordered November, 1899, the foundation work started in August, 1900, and the erection of the buildings and machinery commenced end of February, 1901. It is reasonable to expect that the factory will be in operation, grinding cane, in December. The erection has been superintended by Mr. James Scott for the Honolulu Iron Works Co.

The buildings have been designed in detail, manufactured and erected by Messrs. Milliken Bros., New York, who also furnished the smoke-stack and the traveling crane. The milling plant was built by the Honolulu Iron Works Co. The Corliss engines by the Hooven, Owens & Rentschler Co., Hamilton, Ohio; the Cane Crusher was built by Messrs. Krajewski-Pesant Co., New York; the Cane Unloader by the Bodley-Mallon Co., New Oleans; the Boilers by the Honolulu Iron Works Co.; the Bagasse Carriers and Elevators by the Link-Belt Machinery Co., Chicago; the Juice Weighing Machine by Mr. Baldwin, New Orleans; the Deming Apparatus, Liming and Settling Tanks by Mr. E. W. Deming, New Orleans. The "Lillie" Quadruple-Effect was built by the Honolulu Iron Works Co; the Vacuum Pans, Crystallizers and Filter Presses by the Kilby Manufacturing Co., Cleveland; the Centrifugal Plant by the American Tool & Machine Co., Boston. All Tanks and Piping are furnished by the Honolulu Iron Works

Co; Water Supply Pump and all sugar house Pumps, also the Vacuum Pan Pumps for the "Lillie" Evaporator by Guild & Garrison, Brooklyn. The electric plant is furnished and installed by the Hawaiian Electric Co., Honolulu.

C. HEDEMANN.

Honolulu, Nov. 5, 1901.

REPORT OF THE EWA MILL.

Great changes are being made in this mill, amounting, in fact, to nothing less than building an entire new factory and installing sufficient new machinery to bring the capacity up to about 2,200 tons of cane, or about 285 tons of sugar, in 24 hours.

BUILDINGS: These are entirely new, and constructed of steel structural material with roofs and sides of corrugated iron. All the floors will be of wood, resting on steel floor joists. The main dimensions are as follows:

Two Mill Buildings, each 93 ft. long and 60 ft. wide, 26 ft. to roof trusses.

One Main Sugar House Building, 215x92 ft.—66 ft. to roof trusses.

One Sugar Room Building, 215x32 ft.——37 ft. to roof trusses.

One Sugar Shipping R. R. Shed, 215x21 ft.—18 ft. to roof trusses.

One Boiler House, 133x63 ft.—20 ft. to roof trusses.

Two Cane Carrier Sheds, 100x32 ft.—18 ft. to roof trusses.

One Filter Press House, 98x50 ft.—26 ft. to roof trusses.

All these buildings are connected, forming one factory, and covering 62,014 sq. ft. of ground surface.

Extreme difficulties are being encountered in the erection of this factory, for the reason that owing to the large crop to be taken off this year, it has been impossible to stop grinding in the old works, and as the new buildings are to occupy the same location as the present ones, they had to be so designed that they could be erected clear over the entire old factory, while this is in full, uninterrupted operation. As soon as grinding can be suspended, the remains of the old wooden buildings will be removed, the balance of floors, etc. placed in the new buildings, and the present machinery re-erected in conjunction with the new additional installations.

MACHINERY.—In addition to the present machinery, which is almost all to be used again in the new factory, the following new machinery will be installed:

MILLS.—One complete nine-roller mill, 34x78 inches, in connection with a 32x78-inch cane crusher, all coupled up to one gearing common for both crusher and mills, and all driven by a 30x60-inch Corliss engine. These mills will be fitted with 11-inch Hydraulic Mill Pressure Regulators, and 10-inch on the crusher rolls. The whole milling plant will then consist of two 34x78-inch nine-roller mills with crushers, and both cane carriers will be fitted with Automatic Cane Feeders.

The bagasse leaving these mills will be elevated to a horizontal cross-conveyor conducting it to the boiler room, where it falls on to a horizontal conveyor located over the furnaces. In this conveyor are built adjustable trap doors, regulated from the floor, allowing the proper feed of bagasse to the furnace feeders. These latter are of the roller type, driven by an engine. The surplus bagasse falls either on the firing floor or is conveyed over the end of the carrier into a railroad car.

Boilers.—There will be installed one set of Babcock & Wilcox watertube boilers with 4,000 square feet of heating surface in connection with a Green's fuel economizer. The complete boiler plant will then consist of eight multitubular boilers, each with 1,850 square feet heating surface, and two Babcock & Wilcox water-tube boilers, each with 4,000 square feet heating surface, or, in all, 22,800 square feet heating surface.

The eight multitubular boilers are connected with two iron uptakes, common for all, to a chimney, with four boilers on both sides. The two B. & W. boilers have a common flue passing the gases of combustion through a Green's economizer to an iron stack located outside the end of the boiler building.

Clarification.—The mixed and diluted juices will be pumped from the mill tanks under the juice strainers at the mills up to either one of two automatic juice weighing machines, each with a capacity of 50 tons per hour. From these, it runs into any one of three circular liming tanks, and the limed juice is then pumped through the absorber and digestor of two Deming high temperature clarification apparatus, the size known as "Deming No. 6," each with a capacity in 24 hours of about 240,000 gallons of juice.

The clarified juice is settled in a battery of 24 settling tanks, each of about 1,000 gallons capacity, and the clear juice is drawn down into the two supply tanks for the evaporators.

Evaporators.—The present "Swenson" horizontal quadruple-effect, with a capacity of about 200,000 gallons diluted juice, will remain in operation, and in addition to this is installed a "Lillie" quadruple film evaporator of 350,000 gallons capacity. The total evaporative capacity of the two machines will therefore be 550,000 gallons diluted juice from 15° Brix. to 54° Brix. in 24 hours.

Vacuum Pans.—There are now installed two new vacuum pans, each capable of striking 25 to 30 tons sugar three times in 24 hours. Each pan has 1,000 square feet heating surface, and they are fitted with 2½-inch coils. The present 11-foot vacuum pans will be re-installed in conection with the two new pans; it has eight 4-inch coils and a heating surface of 870 square feet. Room is left on the floor for two additional pans, if later required.

There is a large floor constructed under the vacuum pan room with space for 36 crystallizers, but it is not the intention to install crystallizers for the first season, and the present large cooler car plant will therefore be located on this floor with an addition of 100 cooler cars. The "first" masse-cuite will therefore be discharged direct into the mixers located under the cooler floor, and the second, third, etc. masse-cuite will be discharged from the pans into the cooler cars, which, in turn, will empty their contents into the mixers for second grades. The cooler car system is very perfect and complete in its arrangement of tracks, transfers, Magma pumps, dumping machinery, etc.

Centrifugals.—The present centrifugal plant consists of twenty 30-inch belt-driven Weston centrifugals, all in connection with a mixer divided into several compartments. The new additional installation consists of twelve 30-inch belt-driven centrifugals and thirteen 40-inch water-driven centrifugals. One new Corliss engine will be installed to drive all the belt-driven machines, and a direct-acting duplex pump will force the water into the motors of the water-driven machines. The complete centrifugal installation in Ewa new mill will therefore consist of thirty-two 30-inch and thirteen 40-inch centrifugals, a very large plant, giving ample time for the complete and perfect drying of the sugar in the centrifugals, a most important point, not generally so well provided for.

Filter Presses.—The filter press house is a separate building with an upper floor having room for twenty 500 sq. ft. presses and four 1,000 sq. ft. presses, together with two large receiving tanks for the mud and settlings, and also two Montejus and mud pumps. These presses are arranged in two rows, and the cakes drop through the floor on to two conveyors, conducting all the mud and cakes out to the end of the building and discharging same into two, or more, railroad cars built for this purpose. A 9x14-inch engine drives these conveyors.

The re-arrangement of the present machinery in connection with the extensive new installations in new buildings, means in reality a complete new factory of more than double the capacity of the old one. This is at its best a far more difficult proposition to deal with than if a new sugarhouse should be built with no regard to old machinery, but, as said in the beginning of this article, the difficulties are greatly aggravated in this case, where it has become necessary to continue, to a great extent, grinding and sugar making with the old works, while the new buildings were being erected over the old ones, and new machinery being erected where this could be done. There is no doubt, however, that in the first months of next year, 1902, this difficult task will come to an end, and the Ewa mill will be completed, as the new machinery is now by degrees being started, and the old buildings removed.

The manager, Mr. Geo. F. Renton, has planned and arranged the new factory, and it is being erected under his supervision. The Honolulu Iron Works Co. has assisted principally in making all the necessary drawing work in consultation with Messrs. Milliken Bros., New York, who have designed and manufactured the buildings. The milling plants and crushers are being built by the Fulton Iron Works Co., St. Louis; the new tubular boilers by the Honolulu Iron Works Co.; the two B. & W. boilers and the economizer are furnished by Messrs. C. C. Moore & Co., San Francisco; the Deming clarification apparatus by Mr. E. W. Deming, New Orleans; the juice weighing machines by Mr. J. Baldwin, New Orleans; the "Lillie" evaporator by the Sugar Apparatus Manufacturing Co., Philadelphia; the centrifugals by the American Tool & Machine Co., Boston, and the mixers, tanks and cooler cars by the Honolulu Iron Works Co. The two vacuum pans are being furnished by the Kilby Manufacturing Co., Cleveland, the conveyors for the bagasse and the press cakes by the Link-Belt Machinery Co., and the filter presses by the Honolulu Iron Works Co.

C. HEDEMANN.

Honolulu, Nov. 12, 1901.

PUAKO MILL.

Erected for Mr. John Hind, at Puako Plantation, between Kawaihae and Kailua, Hawaii.

CAPACITY.—This factory is designed to grind at present about 160 tons cane per day of 24 hours' continuous work, with a daily output of about 20 tons sugar. The buildings are, however, built with sufficient extra floor space to admit of a considerable increase in the machinery installations to suit a future greater capacity.

BUILDINGS.—These are all being built of wood framing, covered with corrugated iron on sides and roofs. They consist of:

Mill Room, 54x47 ft. and 22 ft. to roof trusses.
Boiler Room, 31x47 ft. and 2 ft. to roof trusses.
Clarification House, 34x47 ft. and 27 ft. to roof trusses.
Vacuum Pan House, 47x20 ft. and 45 ft. to roof trusses.
Sugar Room Shed, 27x18 ft. and 18 ft. to roof trusses.
Can Carrier Shed, 40x18 ft. and 12 ft. to roof trusses.

The mill and boiler rooms are located in one building, the clarification and vacuum pan houses in one building (with roofs at different heights) and the sugar room shed is located just in front of the centrifugals.

MACHINERY. (For present capacity.)

CANE MILLS.—There will be installed a crushing plant consisting of a six-roller mill with rollers 26 inches diameter and 48 inches long connected to a gearing common for both sets of rollers, and having steel rim gearing wheels and steel crown wheels on both sides of mills. One Corliss engine, 20x48 inches, drives the mills, but is of sufficient power to drive a third three-roller mill to be installed later, making the milling plant ultimately a nine-roller mill.

The mill and gearing beds are constructed in such a manner that the third three-roller mill may be added without disturbing the present arrangement. Each mill is to be fitted with hydraulic pressure regulators and independent accumulators and force pump. The whole milling plant will be of the latest improved design and as complete and efficient as any of the larger mills lately erected.

BOILERS.—There will be installed two (2) multitubular boilers, 6 feet in diameter and 18 feet long, each having 1,700 square feet heating surface, and room has been left open in the building for the installation of a third boiler of same dimensions if required later. The two furnaces are each to be 5 feet wide, and they will be provided with the ordinary stepped grate bars with short horizontal bottom bars—ratio of grate surface to heating surface will be about 1-60. There will be no artificial draught but a number of hot air pipes will be built into the bridge wall. The furnace will be built out from the front of boilers, insuring a clear flame under the whole length of boiler to the rear end, from where the gases of combustion will pass through the 4-inch tubes to the front end and through iron uptakes to an overhead iron flue, conducting them to the smokestack. There will be a damper in each uptake, so that either of the two boilers may be cut out without interrupting the work of the other. The smoke-stack will be 5 ft. diameter and 110 ft. from the grate. It will be made of steel plates riveted together and provided with a brick lining.

The bagasse is elevated from the last set of rollers and delivered into the boiler room on a horizontal carrier over the fronts of the furnaces. This carrier is fitted with a trap door over each furnace, adjustable from the floor, and the bagasse falls on a movable chute, sending it either into the automatic furnace feeders to one side, or on the bagasse floor on the other side, where it may be accumulated in front of a fire door for each furnace, to be consumed should the mills be stopped temporarily and no bagasse be coming from them. The furnace feeders are constructed as iron hoppers provided with an adjustable and automatically opening and closing trap door. The whole system of arranging the milling plant, carriers and bagasse feeders, also setting of boilers, firing, etc., is similar to the arrangement in all the newly-erected sugar houses, only of much smaller dimensions to suit the required capacity of the factory.

Clarification.—The mixed and diluted mill juice runs from a strainer into a juice pump tank of 250 gallons capacity, located under the mill floor. A direct-acting steam pump draws it from the tank and forces it up into an automatic juice weighing machine located at the highest point in the clarification house and directly over the liming tanks. These are at present two in number with room left for a third, and are each of 400 gallons capacity. The juice is limed by milk of lime, of a known density, pumped continuously through a circulating pipe from the slacking and mixing tanks on the ground floor, and the limed juice then enters a receiving pump tank of 100 gallons capacity from which it runs down into a pump of the duplex direct-acting pattern, which forces it through a Deming clarification apparatus known as No. 2, located on the same floor as the liming tanks. This apparatus consists of one digester and one absorber, through the tubes of which the juice passes with a velocity of about 70 inches per second. After being heated by direct steam in the digestor and cooled again in the absorber by the fresh juice, the superheatd juice is conducted through a pipe to any one of three, open, circular settling tanks, each of 600 gallons capacity, and provided with outlets at various levels and try cocks. While only three such settlers will be used at present, floor space will be left open for three similar tanks to be installed later. The clear juice runs by gravitation to the supply tank (of 600 gallons capacity) for the evaporator, located about 10 feet over the floor of the evaporator.

Evaporator.—A "Lillie" automatic film evaporating triple-effect will be installed, of a capacity to reduce 50,000 gallons of juice at 15° Brix. to 54° Brix. in 24 hours, using only exhaust steam of 5 lbs. pressure to the first cell. This apparatus will be complete in every respect, with condenser located at such an elevation that the condensing water will fall from the bottom into the sealing tank in the ground floor, allowing the vacuum pump to work on the "dry" system. The circulating centrifugal pump will be belt-driven by a horizontal 10x12-inch Atlas engine and the vacuum pump will be of the crank and flywheel duplex type. This evaporator may be enlarged later on by inserting a belt with additional tubes in each cell.

Vacuum Pan.—There will be installed at present only one vacuum pan, 6 ft. in diameter and capable of striking sufficient masse-cuite for about 3½ tons sugar. The condenser will be located sufficiently high to allow of the pump working "dry" same as the evaporator. Floor space will be left open on the vacuum pan floor for the installation of a similar pan if required later. The construction of this pan is the usual style with 4-inch coils, using either direct or exhaust steam. The first sugar masse-cuite when discharged from bottom gate of pan, goes through an iron chute direct down into the mixer over the centrifugals and is dried hot as it leaves the pan. This mixer has its upper edge flush with the floor below the vacuum pan floor, and on this large floor, called the cooler floor, is placed a system of tracks all leading to a transfer track ending at the edge of the mixer. On these tracks are run 10 cooler cars, each of 42 cubic feet capacity. When the second masse-cuite is discharged from the pan, these cooler cars are placed in turn under a smaller discharge gate in the pan, and when filled, are pushed back on the floor. When the masse-cuite is ripe for the centrifugals, these cars are transferred on to the track leading to the mixer, into which the contents are dumped by means of a simple hoisting device.

Mixer.—This is of sufficient capacity to hold, with room to spare, a full strike of masse-cuite from one pan. It is at present not provided with stirring apparatus, and is made long enough to accommodate four 30-inch centrifugals.

Centrifugals.—There will be installed two 30-inch Weston's belt-driven centrifugals for the present, but room is left open for two more, when required. The engine will be of sufficient power to drive all four machines, and it will be located on the ground floor. The whole centrifugal installation is on a platform 8½ feet above the ground floor, allowing the sugar to drop from the bottom of the centrifugals into the sugar bags.

Supply Tanks.—The syrup is discharged from the "Lillie" triple-effect into a small 30 gallon receiving tank, from where a steam pump forces it up into any one of the vacuum pan supply tanks, located on the vacuum pan floor. There are four such tanks of 1,000 gallons capacity each, to be used either for syrup or molasses and all are piped in connection with the inlet to the vacuum pan. The molasses leaving the centrifugals runs into a 50-gallon receiving tank, from where it is conducted into either of two molasses blow-up tanks, of 400 gallons capacity each, located on the ground floor. These tanks are fitted with perforated pipes at the bottom, admitting steam to the molasses. There will also be pipes for milk of lime and water to these tanks. The molasses is drawn from these blow-up tanks by a direct-acting steam pump and forced up to any one of the four supply tanks for vacuum pan. The last waste molasses is collected outside in a cistern built for this purpose. Room is left on the ground floor for two additional 400 gallons molasses blow-up tanks when required.

Filter Presses.—The settlings from bottom of the settling tanks are drawn down into a 250 gallon receiving tank located on a floor directly under the settling tank floor, and extending across the end of the building. Close to this tank, and a little below it, is the duplex plunger filter press pump which forces the settlings into either one of two filter presses situated on this floor. The capacity of each press is 200 square feet filtering surface with 24x24-inch frames. The clear juice runs from the presses down into the supply receiving tank for the "Lillie" evaporator, and the mud cakes are dumped through a hole in the floor under each press, through iron chutes through the wall of the building over suitable dumping cars running on a track outside. Floor space is left open for two more such presses and tank.

PIPING.—The main direct steam pipe from the boilers passes through the engine room and clarification house to the vacuum pan house, and from it branches lead to all engines, pumps and coils of vacuum pan. A main exhaust steam pipe line runs almost parallel with the direct steam pipe, and into this is connected all pipes conducting exhaust steam from all engines and pumps, and it leads to the steam chamber of the first cell of the "Lillie" evaporator and the manifold stand pipe for the vacuum pan coils. As the pressure in this exhaust steam pipe should not exceed 5-7 pounds per square inch, it should be provided with a properly adjusted relief valve. The drains from vacuum pans, evaporator and Deming apparatus, should be conducted down to the hotwell, which is located together with the duplex-plunger boiler feed pump in the engine room near the boilers. This hotwell is a closed tank 3 feet 3 inches in diameter and 8 feet long, provided with gauge glass and relief valve. All direct steam and exhaust steam pipes are to be covered with asbestos, as also the cells of the "Lillie" evaporator, Deming digestor and the steam drums on the boilers.

ELECTRIC LIGHT PLANT.—There will be installed a complete electric light plant with engine and generator located in the engine room.

This sugar factory has been designed and planned by the Honolulu Iron Works Co., and all the installations (except the vacuum pan, pipe fittings and buildings) are furnished by this company under a general contract, and Mr. J. Hind superintends the erection of the buildings and machinery himself.

The milling plant, with engine and cane carrier, is being built by the Fulton Iron Works Co., St. Louis. The boilers, furnace feeders, flues, stack, etc., complete, are furnished by the Honolulu Iron Works Co.; the bagasse carrier from mills to furnace by the Chicago Link-Belt Machinery Co.; the juice weigher, Deming, all tanks, mixer, cooler cars, filter presses, and general piping and fittings by the Honolulu Iron Works Co.; "Lillie" evaporator by the Sugar Apparatus Manufacturing Co., Philadelphia; centrifugals by the American Tool & Machine Co., Boston; all small pumps and vacuum pump for vacuum pan by the Geo. F. Blake Manufacturing Co., New

York; the vacuum pump for the evaporator by Guild & Garrison, Brooklyn.

The whole factory is reasonably expected to start grinding cane not later than April, 1902.

C. HEDEMANN.

Honolulu, Nov. 7, 1901.

MILL EXTRACTION.

The question has often been asked, what extraction can be expected by the use of a modern nine-roller mill, with or without cane crusher or shredder. It is impossible to answer this question conclusively, so much depends upon the manner in which the mills are worked and the rollers adjusted, the amount of maceration water used, hydraulic pressure applied, the percentage of fibre and juice in the cane, and, last, but not least, the process used in calculating the extraction.

The writer has found the surface speed of rollers to vary from 18 feet per minute to 28 feet per minute, and the pressure from 275 tons to 425 tons on 34x78-inch rollers, and is in possession of several formulae used in the calculation of sucrose extraction which give apparently different results. For these reasons, it is unfair to criticize the construction of milling machinery and the engineers' manner of working the various mills by simply comparing the daily mill reports as they are issued from the several chemists having control of the mill work. One mill may show poorer results than the neighboring mill but may, in reality, do much better work, if all the conditions were properly considered. In order, however, to give some idea of what our modern mills are doing, the following may be of some interest.

EXTRACTION BY NINE-ROLLER MILLS.

WAIALUA MILL.—Result of two milling tests, under different speeds, with a 34x78-inch nine-roller mill, in connection with a 32x78-inch cane crusher, all built by the Fulton Iron Works Co. in St. Louis. One engine—30x60 inches—drives all the mills and crusher, connected to one train of gears.

	1st Test.	2nd Test.
Revolutions per minute of engine	42	48
Surface speed of crusher	17.57	20.08
Surface speed of 1st mill	18.50	21.13
Surface speed of 2nd mill	21.04	24.04
Surface speed of 3rd mill	21.52	24.60
Dilution per cent of normal juice	23.56	14
Extraction per cent of total sucrose in cane	94.55	93.91
Extraction per cent of total weight of cane	83.77	83.02

Tons of cane ground, first test, 832 95-2000; second test, 1,325 1,860-2,000.

Hours grinding, first test, 23; second test, 22½.

OAHU MILL.—Extract from daily mill reports.

Milling performed April 23rd by a 34x78-inch nine-roller mill built by Honolulu Iron Works Co., in connection with a 26x72-inch Krajewski-Pesant Cane Crusher. All mills driven by one 28x48-inch engine and crusher driven by a separate 16x36-inch engine.

Revolutions per minute of mill engine	46	
Revolutions per minute of crusher	58	
Surface speed of crusher	29.13	
Surface speed of first mill	20.38	
Surface speed of second mill	23.26	
Surface speed of third mill	26.75	
Dilution per cent of normal juice	22.5	
Extraction per cent of total sucrose in cane	94.56	
Extraction per cent of weight of cane	83.00	
Per cent of sugar left in bagasse	4.30	
Per cent of sugar in bagasse per 100 cane	0.86	
Per cent bagasse produced	20.03	
Per cent sucrose in cane	15.82	
Per cent sucrose extracted	14.96	
Per cent moisture in bagasse	42.37	
Hydraulic pressure on first mill	326	tons
Hydraulic pressure on second mill	374	tons
Hydraulic pressure on third mill	416	tons
Tons of cane ground	1,260	tons
Hours grinding	23	

AVERAGE EXTRACTION OF NINE-ROLLER MILLS.

Computed from the annual mill reports of the following seven plantations on the various islands: Ewa, Oahu, Pioneer, Waiakea, Papaikou, Hakalau, and Kekaha, for grind season 1900.

Average extraction per cent of total sucrose in cane	93.79
Average extraction per cent weight of cane	94.20
Maximum sucrose extraction	94.83
Maximum weight extraction	85.91
Minimum sucrose extraction	92.68
Minimum weight extraction	82.68

It is not an established fact that any cane preparer, either crusher, shredder or cutter will, to any marked degree, increase the extraction over mills without such machinery when cane is properly fed, but the capacity of the mills is increased to a considerable extent, in cases to about 25% to 30%, without reducing the extraction.

If it may be allowed to suggest an improvement on present mill work, it should be in the manner of applying the maceration water. At present in many mills, this runs on top of the bagasse leaving the first and second mills in a more or less sluggish spray from a perforated pipe, and it is doubtful whether it penetrates to the bottom of the thick layer of bagasse. In Java, the maceration water is generally furnished to the mills through a cast iron pipe into which are scred a number of small brass nozles, each constructed in such a manner that the water is forced out in a spiral "cork-screw"-like fashion, and penetrates the bagasse with great force. The pressure in the main pipe must be at least 25 pounds per square foot. Such nozzles will be used on the new mills of the Olaa and Hawaiian Commercial & Sugar Co.'s and also at Ewa and Waialua.

C. HEDEMANN.

Honolulu, November 15, 1901.

SAND FILTERS.

It is evident that there is a growing demand in almost all our sugar houses for a good mechanical filter. The settling of the impurities in the juice after leaving the old style clarifiers, or the Deming apparatus, is at the best not entirely satisfactory, and the juice seldom reaches that transparent state of clearness, without floating impurities, which is so much desired. In some few mills, the old style bag filters are still used, and the inconvenience and expense connected with keeping the bags whole, clean and in working order without leaks, are drawbacks well known to every manager. These disadvantages are almost common to all filters using cloths as a filtering medium.

Some years ago, an elaborate system of sand filters was installed in Ewa mill, and a similar installation is now in operation in the Kealia mill. It consists of a large number of open, rectangular tanks, fitted with a perforated plate or strainer, a few inches from the bottom. On this plate is placed a thick layer of beach sand, through which the juice passes to the bottom, from where it is conducted to the next filtering tank, located below the first one, and so on in several rows. Gums and other impurities in the juice will, however, soon choke the top layer of the sand, necessitating every now and then the stirring up of the surface with a rake, to allow the juice to pass down to the lower layers, demanding a great deal of labor and attention, for which reason this filtering process was very soon discontinued in Ewa mill.

Last season, the manager of Oahu plantation imported a battery of eight "Standard" sand filters from Germany. As these are constructed on an entirely different principle and have given great satisfaction, the following brief description may be of interest:

The filter consists of a cylinder about 28 inches in diameter and 6 feet high with conical bottom. In the center of this cylinder is fixed a perforated pipe, 8 inches in diameter, also with a conical bottom, communicating with the delivery pipe. Between this outside cylinder and the perforated pipe, a system of conical rings is arranged in such a manner that one ring stands on the top of the other, the system being completed by a large ring at the bottom. The seats of these rings touch the outside cylinder but leave sufficient space for the juice to circulate. Beach sand is placed between the perforated pipe and the cylinder shell, where it forms a filtering surface between the rings. The juice to be filtered enters the filter through the pipe at bottom, fills the filter up to the air cock, and passes under a slight pressure through the sand to the inner perforated pipe. The filtered juice issues from the delivery outlet at bottom. The coarseness of the sand varies according to the liquor to be filtered. For thin juice a smaller grain is required than for syrup. Under any circumstances, the perforation of the central pipe is regulated accordingly, to prevent the sand from passing through. For ordinary diluted mill juice, the perforations in the inner tube are about 400 per square inch, same as centrifugal lining.

As soon as the sand is saturated with impurities, water is admitted to expel the remainder of the juice which is being filtered. The outlet below is then opened while the water is entering, and the sand washed out. The filter is now empty and clean again, ready for refilling. After washing the sand with running water and by means of an injector, the whole of the scum quickly separates, and the sand is again ready for use in the wet state.

The dirty sand is dropped into a tank provided with a perforated steam pipe and running water, for instance, the discharge water from condensers. The steam agitates and separates the sand from the dirt, which is washed away, and the clean sand is elevated to a hopper over the filters and used again. The efficiency of this filter is shown by the fact, that not only the external surface but the whole mass of sand is penetrated by the deposit of dirt from the juice.

The following data with regard to the actual work of these filters has been obtained from the chemist of Oahu Mill, viz.:

"Our eight sand filters have a sufficient capacity to handle the juice from 1,200 tons of cane per 24 hours; they are washed out every 12 hours, two at a time. Two men handle them; if at times assistance is needed, a man from the filter presses helps them out. The heating surface of evaporator and vacuum pans keep decidedly cleaner and the centrifugal capacity is remarkably increased, mainly when our second product is being dried."

To this it may be added, that it takes about 30 minutes to clean the sand in the tank arrangement at Oahu Mill, 10 minutes to empty and clean out a filter, and about 30 minutes to refill it and get it started.

Over fifty such filters are now being sent out from Germany to be installed in the various sugar houses under the control of Messrs. H. Hackfeld & Co., and the Honolulu Iron

Works Co. is building eighteen, ten of which are for the Hawaiian Commercial & Sugar Co.'s new mill, and eight for the Honolulu Sugar Co. The sand washing machine for the first mentioned place, will consist of an inclined revolving drum and will be *self-acting*. The dirty sand enters the upper end and escapes clean at the lower end, while a stream of water passes through the drum in the opposite direction.

C. HEDEMANN.

Honolulu, November 14, 1901.

CENTRIFUGAL WORK.

With the few available data at disposal on centrifugal work in our sugar houses, it is at present impossible to decide whether the water-driven centrifugals are superior to the belt-driven ones, and whether the 42-inch and 40-inch machines are of a correspondingly greater efficiency than the usual 30-inch machines. It is, however, safe to state, that the water-driven machines have the advantage over the belt-driven machines, that they are less complicated in their construction, take up less room, and have none of the disadvantages connected with keeping belts in running order and looking after a lot of complicated friction and other pulleys, fast running shafts, etc. With regard to economy in use of steam, the time allowed for the completion of this report has not permitted of proper tests being made to ascertain the horse-power developed in engines and steam pumps driving various centrifugal installations, but we believe that a well-proportioned pumping engine, preferably of the crank and flywheel pattern, will give as good economy in working the water-driven machines as any engine with the belt-driven machines. The efficiency of various installations may be judged from the following results of work actually performed here during the last season, but no conclusive deductions should be made by comparison of these various results, as the amount of dry sugar purged from a machine in a certain time depends to the greatest extent upon the quality of the molasses in the masse-cuite to be dried. In some mills, the centrifugal plant is so efficient that a great deal of extra time could be given to the proper drying of the sugar, whereas in other mills, there are so few machines, that sugar occasionally is purged before being fully dried, so as to give room for a new strike ready to be discharged.

In comparing the efficiency of a 40-inch machine with a 30-inch machine, Mr. J. N. S. Williams deals with this question theoretically as follows:

"One 30-inch Weston's centrifugal running at 1,200 revolutions per minute will dry about 150 pounds of No. 1 sugar per charge, and will take on an average 12 charges per hour.

"The centrifugal force generated in this charge of sugar when this machine is running at its maximum speed=.00034x 150x1.125x1,200^2=82.629 lbs.

"One 40-inch Weston's water-driven centrifugal running at 850 revolutions per minute will dry about 400 pounds of No. 1 sugar per charge, and will take in an average of 8 charges per hour.

"The centrifugal force generated in this charge of sugar when machine is running at its maximum speed=.00034x400 x1.5x850^2=147.390 lbs.

"But it is not the centrifugal force generated in the sugar but that generated in the molasses which leaves the sugar, that must be taken into consideration.

"To compare the two machines, take one pound of molasses and determine the centrifugal force at the periphary of the basket in each case thus:

"In the 30-inch machine .00034x1x1.125x1200^2=612 lbs. being the centrifugal force generated in one pound of molasses at the surface of the revolving screen.

"In the 40-inch machine .00034x1x1.66x850^2=438 lbs.

"Thus the drying power of the 30-inch machines seems to be 40% in excess of that of the 40-inch machines. If the 40-inch machine should develop the same drying power, it must run at, $\sqrt{\frac{612}{.00034 \times 1 \times 1.66}}$=1,041 revolutions per minute."

Two tests made with 40x24-inch water-driven American-made centrifugals drying No. 1 sugar at Waialua, Oahu.

TEST No. 1.—Pressure—on water—140-145 lbs. per sq. in.
Two water jets opened 30 seconds in starting.
Masse-cuite treated in crystallizers 4 hours before drying.
One quart water used in each centrifugal.
Duration of test, one hour.
Number of charges, 6.
Total of dry sugar, 2,517 lbs.
Average weight of charge, 419½ lbs.
Polariaztion of sugar, 97.8.
Average time per charge, 10 minutes.

TEST No. 2.—Pressure—on water—170-180 lbs. per sq. in.
One water jet opened.
Masse-cuite treated in crystallizers 4 hours before drying.
One pint water used in each centrifugal.
Duration of test, one hour.
Number of charges, 10.
Total of dry sugar, 4,303 lbs.
Average weight of charge, 430.3 lbs.
Polarization of sugar, 97.6.
Average time per charge, 5.9 minutes.

Two tests made with 40x24-inch water-driven American-made centrifugals drying No. 1 sugar, at Spreckelsville, Maui.

TEST No. 1.—Duration of test, one hour.

Number of charges, 7.
Weight of average charge, 411.7 lbs.
Total of dry sugar, 2,880.25 lbs.
Average time per charge, 8.2 minutes.
TEST No. 2.—Duration of test, one hour.
Number of charges, 6.
Weight of average charge, 403.2 lbs.
Total of dry sugar, 2,420.25 lbs.
Average time per charge, 8.835 minutes.

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Centrifugal work at Oahu mill with Watson, Laidlaw & Co.'s water driven machines, 42x20 inches.
Pressure on water, 160-180 lbs. per sq. in.
umber Nof charges in one hour, 5.
Average time per charge, 20 minutes.
Average weight per charge, 330 lbs.
Total sugar per hour, 1,650 lbs.
Masse-cuite, 71% purity.
Sugar, 80° polarization.

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Test made with 42x20-inch Watson, Laidlaw & Co.'s water-driven centrifugals, drying No. 1 sugar, at Waianae, Oahu, June, 1901.

A set of eight centrifugals are driven by a "Worthington high-pressure pump" size 16x8½x20, making from 40 60 strokes per minutes under a steam pressure of 75 lbs.
Pressure, 145-150 lbs.
One 3-8-inch water jet.
Speed of basket, 850 revolutions=9,341½ circumferential feet per minute.
Average charges per hour (1 centrifugal), 8.
Average time per charge, 7½ minutes.
Average pounds of sugar per charge, 411.
Total sugar per hour, 3,288 lbs.
Polarization, 96.5.
Juice: Brix. 18.63. Sucrose, 15,63. Purity, 83.89.
Syrup: Brix. 53.56. Sucrose, 45.93. Purity, 85.75.

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Test made with 30-inch belt-driven centrifugals (of American Tool & Mach. Co.'s make) at Ewa Mill, on 1st sugar.
Duration of test, 1 hour.
Number of charges, 19.
Average time for one charge, 3 1-3 minutes.
Average weight of one charge, 175.63 lbs.
Total weight of sugar dried, 3,337 lbs.
Juice purity, 84.4.
Syrup purity, 86.2.
Note.—This is a most extraordinary performance of centrifugal work and can only be explained by exceptionally free drying sugar and unusually skillful work of the centrifugals.

Two tests made with 30-inch belt-driven Hepworth centrifugals at Pioneer Mill, Maui.

TEST No. 1.—(By a first class man.)
Number of charges per hour, about 12½.
Average weight per charge, 154 lbs.
Total weight of sugar dried per hour, 1,980 lbs.

TEST No. 2.—(By an ordinary man.)
Number of charges per hour, 12½.
Average weight per charge, 132 lbs.
Total weight of sugar dried per hour, 1,640 lbs.
Polarization of sugar, 96.8°.

Note.—Large quantities of re-melted 4th sugars were taken into the masse-cuite, so better results with regard to efficiency would have been obtained by drying No. 1 sugar from unmixed masse-cuite.

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As will be seen, the above results of actual test work of centrifugals here are so variable that they cannot serve to establish any general rule for efficiency.

It is, however, safe to estimate that a 40-inch centrifugal in our sugar houses will discharge 7½ times per hour 400 lbs. sugar, or 3,000 lbs. per hour; and the old rule seems to hold good, that one 30-inch centrifugal will discharge 2,000 lbs. sugar per hour, this mentioned merely for sake of comparison.

It is a very crude manner in which water is generally applied to the centrifugals, by means of a tin full of water washed against the spindle while running. In Oahu, they have used for two seasons a system of spray nozzles, manufactured for this purpose. The water enters a jointed pipe with a pressure of about 150 lbs. per square inch and in the end of this pipe is a peculiarly constructed nozzle, which expels the water in the finest possible spray, almost as a white cloud. The pipe with nozzle is lowered into the basket and the fine spray penetrates the masse-cuite and sugar absolutely even, preventing lumping and uneven coloring of the sugar. After the spray has been applied, a jet of compressed air is forced against the inner wall of the sugar, and helps greatly in driving the water out.

In conclusion, the following remarks may be permitted: It is the proper and thorough centrifugal work which principally gives our sugars the keeping qualities for long shipments, no after drying in heaters or by fans will complete what has been left undone in the centrifugals, and an apparently excessively large centrifugal plant in a sugar house is the best investment.

C. HEDEMANN.

Honolulu, November 15, 1901.

MR. C. HEDEMANN, Chairman of Machinery Committee, Honolulu.

DEAR SIR:—I can say in reply to your inquiry, that we have a Hersey Granulator, and while at first I could not figure that there was any particular advantage in its use, as the loss in weight through extraction of all moisture, under the old refinery contract was hardly made up, in some instances, by the price of improved polarization. But am now using it constantly and am well satisfied that, for us at least, it is a good thing. The sugar, however indifferently it may be dried in the centrifugals, comes through the granulator in a thorough condition of dryness. Of course if any portion of the sugar discharged from the centrifugals contains actual molasses, that portion will roll about in the machine and be only partially dried, but so long as this is guarded against, there is no difficulty in handling wth supreme satisfacton both No. 1 and No. 2 sugars.

The sugar dried by the granulator polarizes as high in New York as does sugar dried in the ordinary way before it leaves the sugar room, and in a few instances has exceeded in New York its mill weight. This, however, is exceptional, and as a rule there is a slight loss of weight in transit, which I am inclined to think is due to leakage.

We have very inferior cane this season, due to drought during growing months of last year and six months of this, and consequently an inferior quality of sugar. Of one shipment to New York, a portion had been run through the granulator, and a portion dried in the ordinary way. The former lost in transit about ½ a degree in polarization, No. 1 and No. 2, and the latter a loss of 1½ degrees No. 1 and 2 degrees for No. 2 with a loss in weight of nearly 1½ per cent. The weight of granulator dried sugar was a few pounds in excess of mill weights. I might mention that this particular shipment was stored a considerable time in our warehouse waiting shipment.

My last sugar boiler was not able to determine the exact weight of moisture extracted during drying, so will not touch on this point. Yours truly,

JNO. HIND.

C. HEDEMANN, ESQ., Chairman Committee on Machinery, Honolulu.

DEAR SIR:—In answer to your letter of the 14th of last month regarding machinery, the only improvements which we have made in our mill machinery in the past twelve months are the installation of a "Lillie" triple-effect and a cane carrier feeding machine. The "Lillie" has a capacity of 120,000 gallons in 24 hours. The cane carrier feeding machine was made at the plantation and is called the "Wick's Patent Cane Carrier Feeder."

The "Lillie" is doing all that was claimed for it and we are well satisfied with it. When our mill was running at full capacity, the old (7x7x6 ft.) Standard triple-effect could not do the work we required of it and the maceration was cut down to about 8% and the syrup was pumped out at a density of about 24° B. With the "Lillie," we have increased the maceration to 15%. Before going further, I beg to add that we press the mud twice by diluting in a tank containing 1,000 gallons of hot water, and then by pumping this mixture through a second set of presses, we get the sucrose in the cake down to an average of 1½% and the density of the juice from the second presses to 2° Brix. (corrected). This juice we used for maceration when we had the Standard effect in operation but since we have been working the "Lillie," all the juice from the second presses is run direct into the receiving tank of the "Lillie," and as I said before, the maceration at the rollers is 15% with water direct from the hot-well. The syrup is pumped from the "Lillie" at a density of 30° B. and we are not using so much steam to run the "Lillie" as it took to run the old effect, or, in other words, the "Lillie" is doing twice the work that the Standard effect was doing and with the same amount of steam. We do not find the same difficulty in keeping the "Lillie" clean that we did with the Standard effects but we find that either machine is easiest kept clean when we are running day and night. There is practically no entrainment in the "Lillie."

Regarding the cane carrier feeding machine, this is a machine which we made at the plantation and the idea originated with our engineer, who has patented the machine. After the 14th of June, 1900, we had great difficulty in getting men to work at the cane carrier, and the need of a machine to do this work impressed itself upon us so much that we saw something had to be done and done quickly. The engineer put on his "thinking-cap" and in a few weeks he had the machine at work. During the year which we have had it at work, it has given every satisfaction. It is worked by two men but for the coming season we intend to operate it with one man. It is doing the work of seven men and we have always a good feed at the rollers, a much better supply of cane for the mill than when all the work was done by hand. It is a very inexpensive machine and takes little power to run it. We run it with a 3-inch belt from the shaft of the "Smith" cutter. The machine can be lowered or raised to any angle and it will feed the carrier at any point within fifteen feet of the center of itself on either side. It can be raised or lowered or swung to either side while in motion. It is unnecessary for me to go into details as to the construction of the machine as you will have drawings of it by this mail. One great advantage of this machine is that there are never any empty spaces on the cane carrier.

I remain, yours very truly,

J. WATT.

CRYSTALLIZATION IN MOTION.
(At Oahu Plantation.)

Make as much first product as you can. If you succeed in making only one grade of sugar, there is nothing more to wish for. This should be the aim every sugar manufacturer should strive after. This was our idea right from the beginning, as soon as the Oahu Sugar Company's plant was put up, and we have come nearer to it than any other mill in the Hawaiian Islands. On an average, we made last season 95.2% of first product, polarizing 98.37° when this sugar left the mill. Oahu Sugar Co.'s mill was the finest one of a series of new enterprises in this country and satisfactory results have been obtained with the process of crystallizing the sugar in motion.

The crystallizers imported into this country, though built by different parties, are all of the same shape and on the same principle. In Europe and in Java there are nearly a dozen different kinds of crystallizers and I would not be surprised if other styles will be advocated within the next couple of years, therefore I consider it necessary to call attention to the construction of these apparatus. It is necessary that the whole bulk of masse-cuite is kept in motion, that not a part of it, or at least as small a part as possible, remains quiet, thus preventing the settling of any masse-cuite on the inner wall of the apparatus and equalizing the cooling off over the whole mass; furthermore, should the upper part of the masse-cuite not be in contact with the stirring apparatus, then naturally the surface cools off quicker, a crust forms on the top of it and prevents the radiation of the heat upwards. It is natural that an even cooling of the masse-cuite can not be acquired in such an apparatus and the regular development of the crystals is impossible; while in that part of the crystallizer which come in contact with the stirrer, an even, though slower, cooling gives the crystals a better size, the mass remains at rest in the dead spaces and while here in some parts a fast and in others a slow cooling takes place, opportunity is given for the building up of irregular and also of false grain. Crystallizers have been built in different shapes, like the well-known mixers commonly used above the centrifugals, or like an ordinary trough; others in perfectly cylindrical form with an opening which can be hermetically closed; others with a slit in the top over the whole length. The first two forms have been abandoned entirely and the third is the only style of construction which is accepted of late in Java. By crystallizers built in the first two shapes, the masse-cuite frequently would not dry any more as soon as the level was sunk so far, that the part of the strike which had been cooled in the dead space, dropped into the centrifugals. Examination of the crystals under a magnifying glass proved a considerable amount of false grain.

The stirrer should be built in a spiral-like form and the rotation move in such a direction that it conveys the masse-cuite towards the outlet opening. Stirrers made like a shaft with arms fastened on same are imperfect when these arms are not connected with each other on the extreme ends, be it either in a straight or a spiral-like direction, because they do not move the masse-cuite evenly and a large part of the walls do not become scraped off.

Crystallizers with a jacket for cold water are considered the best; precautions, however, should be taken that the temperature of the water is distributed over the whole inner surface of the jacket evenly; furthermore, to force a quicker cooling at times it is necessary to have this jacket made to stand a certain given pressure. The cooling should be kept under strict observation, not only for reasons to be stated afterwards, but care should also be taken that the transmission of the heat is not prevented by incrustation, accumulation of dirt, etc.

The water-jacket can also be used to heat the masse-cuite with hot water or steam, to dissolve false grain, which might have been formed during the cooling; but only when the masse-cuite is of a comparatively high purity and the false grain present only in small quantities, this succeeds fairly well. By bringing the purity of the molasses so far down as we do, it is impossible to dissolve any false grain, even by a large increase of heat, which would take hours to do. On one occasion we tried this and with very poor success. False grain should not and will not crystallize out when you are provided with properly constructed vacuum pans and crystallizers and when proper care is taken during the boiling process.

I want to say a few words about the vacuum pan itself. The boiling of the masse-cuite when it has to be prepared for a crystallizer is entirely different from the usual method and quite different demands are made on this apparatus. The modus operandi of crystallizers requires large quantities of molasses to be mixed with the first masse-cuite; when you cannot reduce the quantity of first masse-cuite to be boiled in every strike, so as to add a sufficient amount of molasses to it, without deranging the regular work in the boiling house, you will have to enlarge the boiling station.

As the purity of the syrups and molasses vary constantly, different quantities of them have to be mixed. The amount of molasses varies from 30-50% on the total mixture. It is understood that these molasses are added after the syrup has been boiled to a properly finished masse-cuite. It is therefore easily conceived that vacuum pans which under former given conditions did fairly good work, may not be able without undergoing a great alteration to adapt themselves to a higher task. Vacuum pans which allow little circulation of the mass to be boiled on account of wrongly constructed steam coils, should not be used; one cannot boil the masse-cuite to the proper concentration, because the molasses which are drawn in afterwards do not mix properly and if it apparently is done, it can only be effected under loss of time, still never a proper homogeneous mass will ever be obtained. There are remedies to better an imperfect circulation, for instance, by introducing a perforated coil just above the bottom of the pan through which dry steam is blown directly into the masse-cuite (patent Claassen).

In the Hawaiian Islands, Mr. Froboese patented a device of an improved construction also for the same purpose. We have adopted this latter contrivance with fully satisfactory results; we gained 10% in time boiling.

A similar coil as spoken of above (Claassen) but with larger holes, to be connected with the suction pipe, will improve the distributing of molasses in the masse-cuite.

It takes as much time to boil a strike in a large pan as it does in a small one of similar construction, therefore one sugar boiler can make much more sugar with less work and less strain and can therefore concentrate all his energy to one point. This is mainly the reason why a big pan was put up in our plant. Accompanying rough sketch shows a cross-section of our large 50 ton vacuum pan, dimension are given.

(Continued in Our Next.)

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The use of Chile saltpetre and kainite for fertilizing beet soil, which is being recommended of late, requires the greatest caution and is permissible only under certain conditions. Generally speaking it is not profitable, since the increased amount of salts and non-sugar matters interferes with the extraction of the sugar, that is, leaves more sugar in the molasses, which more than makes up for the augmented weight of the beets. In fertilizing experiments the examination should embrace not only the total weight of the beet and the ratio of sugar, but also the nature and quantity of the ash, in which case the conclusions are apt to be very different.—D. Zuck, Ind.

Old saying: "All comes to him who waits." In its place is this: "All comes to him who hustles."